INSTRUCTION BOOK FOR

RA-10 Aircraft

RADIO RECEIVING EQUIPMENTS

TYPE RA-10C, RA-10D, RA-10CD *and* RA-10DD

BENDIX RADIO

REG. U.S. PAT. OFF.

DIVISION OF BENDIX AVIATION CORPORATION
BALTIMORE 4, MARYLAND, U. S. A.

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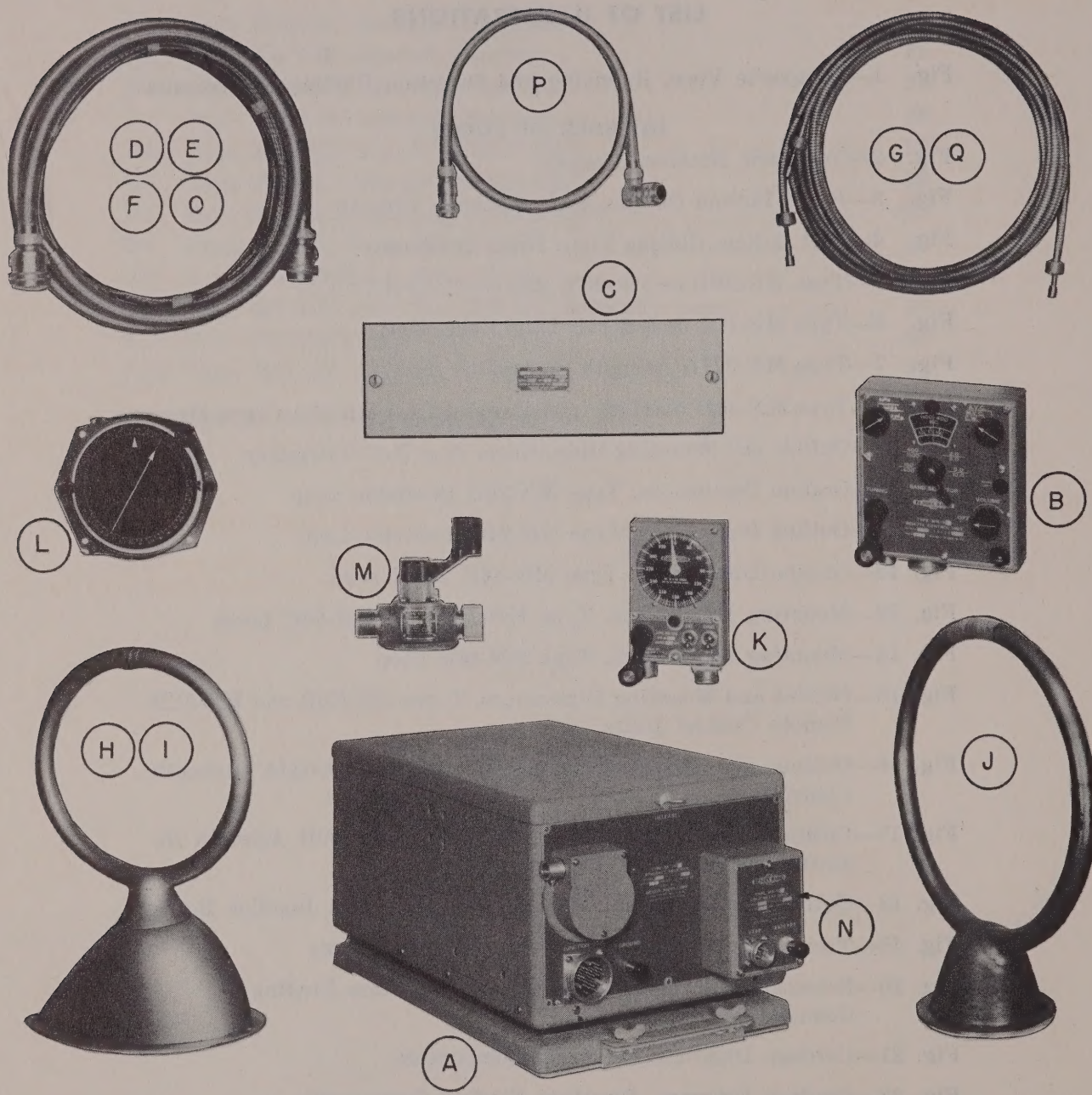

Fig. 1—Composite View, Receiving and Direction Finding Components

Instruction Book for

RA-10 Aircraft Receiving Equipments

1. INTRODUCTION

1-1. FUNCTION

The Type RA-10C, Type RA-10D, Type RA-10CD and Type RA-10DD Aircraft Receiving Equipments are designed for aircraft and mobile service. This equipment may be employed for the reception of continuous wave, modulated continuous wave, or radio telephone signals in two frequency ranges, from 150 to 1100 kilocycles and from 2000 to 10,000 kilocycles. Two bands are used to give full coverage in each frequency range.

Aural direction finding and loop antenna reception may be obtained by using this equipment in conjunction with the components listed in Section 1-2-2.

Provision has been made for two lock-in crystal controlled frequencies, one each in bands 3 and 4 in Types RA-10C and RA-10D; and one each in bands 1 and 3 in Types RA-10CD and RA-10DD. When specified on order, bands 3 and 4 may be wired so that the crystal controlled fixed frequencies only are available, thereby eliminating the necessity of tuning the RF circuits to the approximate crystal frequency. When the receiver is wired for general coverage of bands 3 and 4 in Types RA-10C and RA-10D or bands 1 and 3 in Types RA-10CD and RA-10DD, and the crystal is in use, lock-in occurs over a band-width of at least 40 kilocycles.

The Type RA-10C and Type RA-10CD Equipments are used for operation from a 14-volt direct current power source; the Type RA-10D and Type RA-10DD Equipments, which are similar except for low voltage circuits, are used for 28-volt direct current installations. The equipments are designed for remote control operation only.

1-2. COMPONENT UNITS

1-2-1. TYPE RA-10C AND RA-10D RECEIVING EQUIPMENT (See Fig. 1)

Item	*Quantity*	*Description*	*Weight, Lbs.*
A	1	Type RA-10C, Type RA-10D, Type RA-10CD or Type RA-10DD Aircraft Receiver complete with shockproof mounting; one set of tubes as follows: 1-6C5, 2-6K6G, 1-6K8, 1-6R7 and 3-6SK7.	32.5
B	1	Type MR-9BB or Type MR-9CB Remote Control Unit.	2.25
C	1	*Type MS-14B Junction Box	2.44
D	1	†Receiver to Junction Box Cable AC59887-1 Straight Cannon Plug one end, conduit clamp on other end. AC59887-2 Right Angle Cannon Plug one end, conduit clamp on other end.	0.3
E	1	†AC62908-1 Remote Control to Junction Box Cable	0.26
F	1	†Battery to Junction Box Cable AC59727-1 Conduit Clamp on both ends. AC59727-3 Conduit Clamp on one end, ferrule and coupling nut on other end.	0.16
G	1	†A15410 Tuning Shaft (Flexible)	0.265

NOTES: Crystal and holder Type MX-9E are furnished only on special order. See Section 2-1-2-11.

*Location of cable entering holes to be specified by customer; larger sizes of junction boxes may be obtained when interconnections with other equipments are desired. (See Fig. 8).

†Length to be specified by customer. Weights are specified per foot of length.

Where this equipment is to be installed with a Type TA-6A Transmitter Equipment, no Battery to Junction Box Cable AC-55848-1 is required as the connection to the power source is made by means of jumpers in the Type MS-14B Junction Box. Only one Junction Box MS-14B is required for combined installation.

1-2-2. TYPE RA-10C AND TYPE RA-10D RECEIVING AND DIRECTION FINDING EQUIPMENT

If the Type RA-10C and RA-10D Receivers are to be used for radio reception, aural-null direction finding, and anti-static radio reception, the following components will be required in addition to those listed in Section 1-2-1: (See Fig. 1)

Item	*Quantity*	*Description*	*Weight, Lbs.*
H	1	Type MN-20E Rotatable Loop. Furnished with one Type MS-52A Right Angle drive on order.	5.0
		or	
I		Type MN-24C Rotatable Loop. Furnished with one Type MS-52A on order.	6.8
		or	
J		Type MN-46B Fixed Loop	2.69
K	1	Type MN-52JA Azimuth Control	0.975
		or	
L		Type MN-40D Azimuth Indicator	2.1
		with	
M		Type MR-15A Crank Drive	0.375
N	1	Type MR-11C or Type MR-11D Loop Relay Unit, complete with mounting hardware, for 14 volt or 28 volt operation respectively.	1.0
O	1	*Azimuth Control to Junction Box Cable (Not required with fixed loop or when Type MN-40D Azimuth Indicator with Type MR-15A Crank Drive is used) AC58267-1 Straight Cannon plug on one end, conduit clamp on other end. AC58267-2 Right Angle Cannon plug on one end, conduit clamp on other end.	0.13
P	1	*Loop Transmission Cable Assembly, Standard Length 6 feet (up to 12 foot lengths special) AC55966-1 Straight Cannon Plug on one end, Right Angle Cannon Plug on other end. AC55966-2 Straight Cannon Plugs on both ends. AC55966-3 Right Angle Cannon Plugs on both ends.	0.15
Q	1	*A15410-1 Azimuth Control Shaft† (Flexible)	0.265
R	1	*AA26172-1 Dial Light cable assembly for Type MN-40D Azimuth Indicator (Not used with Type MN-52JA Azimuth Control).	0.2

NOTES: Items K, L, M, Q and R are not used in fixed loop installations.
*Length to be specified by customer. Weights are specified per foot of length.
†Two Azimuth Control Shafts are necessary when the Azimuth Incidator MN-40D with Crank Drive MR-15A is used. (See figure 19).

1-3. ADDITIONAL EQUIPMENT REQUIRED

The following additional items must be provided by the customer:

Item	*Quantity*	*Description*
S	1	14-volt direct current power source as required for the RA-10C and RA-10CD Equipments or 28-volt direct current power source as required for the RA-10D and RA-10DD Equipments.
T	1	Antenna. Any standard fixed or trailing wire antenna such as is usually installed on aircraft.
U	1	One or more pairs of 600-ohm low-impedance headphones to be used with Type MR-9BB Remote Control Unit. High-impedance, 4000-ohm headphones are used if the equipment has been ordered with the high-impedance output circuits in the Type MR-9CB Remote Control Unit.

1-4. PERFORMANCE CHARACTERISTICS

1-4-1. GENERAL

The Type RA-10C, RA-10D, RA-10CD or RA-10DD Receiving Equipment satisfies all requirements for airline aircraft radio equipment in accordance with the Civil Aeronautic Authority Specification C.A.R. 04.503. Accordingly, the equipment has been granted Civil Aeronautics Authority Type Certificates 465 (RA-10C), 466 (RA-10D), 960 (RA-10CD), 881 (MR-9BB), 882 (MR-9CB), 384 (MS-14B), 385 (MS-14C), 996 (MN-20E), 953 (MN-24C), 807 (MN-46B), 965 (MN-52JA), 873 (MN-40D), 98 (MR-15A), 469 (MR-11C), 470 (MR-11D), 296 (MX-9E), and 954 (RA-10DD).

1-4-2. SENSITIVITY

The modulated continuous wave (MCW) sensitivity, when measured at a signal to noise power ratio of 4:1, is better than five microvolts input for 50 milliwatts output with the proper load.

The continuous wave (CW) sensitivity, when measured at a signal to noise power ratio of 10:1, is better than 2½ microvolts input for 50 milliwatts output with the proper load.

1-4-3. POWER OUTPUT

The Type RA-10C, RA-10D, RA-10CD and RA-10DD Aircraft Receivers are designed for either a 600- or 4000-ohm load and will deliver over 500-milliwatts output at not over 10-percent distortion when properly loaded. The maximum possible output is approximately 1 watt.

1-4-4. SELECTIVITY

The selectivity of the Type RA-10C, RA-10D, RA-10CD and RA-10DD Receivers is indicated by the ratio of the input voltage off resonance to the input voltage at resonance, at a given band-width; and is observed by varying the input voltage to maintain a constant output level for frequencies off resonance. Typical selectivity figures for the receivers at representative frequencies is tabulated below.

Resonant Input	*Total Band Width for Reference Frequencies*					
	150 Kcs	*400 Kcs*	*1100 Kcs*	*2000 Kcs*	*5000 Kcs*	*10000 Kcs*
X10.....	5.5 Kcs	7 Kcs	8.5 Kcs	11.5 Kcs	10 Kcs	10.5 Kcs
X100.....	10.5 Kcs	13 Kcs	15.5 Kcs	21.0 Kcs	22.5 Kcs	23.0 Kcs
X1000.....	17.0 Kcs	20.5 Kcs	22.0 Kcs	31.0 Kcs	34.5 Kcs	35.0 Kcs

1-4-5. IMAGE REJECTION

The discrimination against image frequencies over the various ranges of the Type RA-10C, RA-10D, RA-10CD and RA-10DD Receivers are given in the following table:

Band	*Frequency*	*Minimum Ratio*
1	400 Kcs	10,000:1
2	1,100 Kcs	5,000:1
3	5,000 Kcs	1,400:1
4	10,000 Kcs	1,000:1

NOTE: As the frequency specified in each band is that at which the image rejection is poorest, considerable better minimum ratios will be assured for all other frequencies.

1-4-6. AUTOMATIC VOLUME CONTROL ACTION

The automatic volume control (AVC) action will hold the output constant within eight decibels for a 10,000 to 1 change of input signal voltage.

1-4-7. AUTOMATIC SIGNAL LIMITER ACTION

The automatic signal limiter action starts at approximately ¼ volt on the antenna. It will allow AVC operation with signal inputs up to 2.5 volts without blocking out. (See Section 2-1-2-7.)

1-4-8. CALIBRATION

The dial located on the Type MR-9BB or MR-9CB Remote Control Unit is directly calibrated in kilocycles on the two low frequency bands and in megacycles on the two high frequency bands. The calibration accuracy of this dial is better than 1%.

The calibrated end limits of each band are as follows:

Band 1	150. — 400. Kcs
Band 2	400. — 1100. Kcs
Band 3	2. — 5. Mcs
Band 4	5. — 10. Mcs

1-4-9. POWER CONSUMPTION

The total current drain of the Type RA-10C or Type RA-10CD Receiver, exclusive of relay current, will not exceed 6.0 amperes at 14 volts direct current, or when the Type RA-10D or Type RA-10DD Receiver is used, 3.0 amperes at 28 volts direct current.

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2. DETAILED DESCRIPTION

2-1. TYPE RA-10 RECEIVERS

2-1-1. MECHANICAL

All major components of the receiver are mounted on an aluminum alloy chassis which is in turn welded to the sides of the receiver case proper, thus producing a very rigid unit. The receiver case assembly is provided with removable top and bottom covers made of heavy gauge aluminum alloy. The bottom is permanently attached, by means of four Lord shock-mounts, to the upper mounting base. The upper mounting base is held securely into a recessed mounting base by two thumb operated Dzus fasteners. The lower mounting base should be permanently attached to the airplane. The outer surfaces of the receiver are covered with grey wrinkle-enamel.

The variable capacitor is driven by a flexible shaft from the Type MR-9BB or MR-9CB Remote Control Unit, through a worm and worm-gear assembly which is mounted to the front of the receiver in such a manner that it may be rotated in steps of 30°, thereby permitting the tuning shaft to leave the receiver at the most desirable angle for the particular installation. The worm-gear is spring-loaded to reduce any possible backlash to a minimum.

With the top and bottom removed, the receiver may be rested on any of five sides without possible injury to any of the component parts.

The receiver is so designed that the Type MR-11C or MR-11D Loop Relay Unit may be mounted on the front of the receiver should it become desirable to operate the receiver in conjunction with a loop antenna. See Section 3-3-6 for details concerning the mounting of this unit.

2-1-2. ELECTRICAL CIRCUITS

2-1-2-1. Voltage Supply Circuits

A. Input to the Power On-Off Control

Connection is made from the aircraft storage battery and charging system through the battery cable to the junction box, and thence through the receiver to junction box cable to the side-tone relay and through the remote control to junction box cable to the protective fuse F101 and power on-off switch S104 mounted integrally with the volume control located in the remote control unit. Return circuits are carried in the various common ground leads.

B. Low Voltage Circuits

When the power on-off switch S104 is turned on, voltage is applied to the instrument lamp I101 and through the interconnecting cables and junction box to contact 22 of the receiver cable receptacle J1. This low voltage is then distributed to the band switch motor circuits, the filament circuit, the crystal on-off relay K1, the dynamotor-filter circuit, and when associated direction finding equipment is used, to the azimuth control instrument lamp switch. The resistor R103 limits the instrument lamp voltage to a safe value. Proper vacuum tube heater voltage, 6.3 volts, is obtained by wiring the heaters in a series parallel arrangement, see Section 2-9. The unoperated or normal position of the side-tone relay provides continuity of the receiver output circuits. The unoperated or normal position of the crystal on-off relay K1 grounds the grid side of the crystals thereby allowing the heterodyne oscillator to function in the normal manner. When the crystal on-off switch S103 is turned on, the contacts of relay K1 move to the open position (crystal lock-in). With the relay in the energized position a holding coil is inserted in series with the initial starting relay coil. The purpose of this holding coil is to limit the amount of current required to hold the relay in the energized position to a minimum.

C. High Voltage Circuits

When the power switch S104 is turned on, power is supplied through the line filter C78A, C79A, C79B, L6 and L7 to the primary side of the dynamotor D1. The secondary of the dynamotor feeds high voltage through the filter C77A, C77B, C77C, C78B, C78C, and L5 to the vacuum tube plates, screens, and the cathode bias bleeder. The cathode bias voltage is dropped to the proper value by the bleeder system composed of R33, R34, and the volume control circuit. When manual volume control

(MVC) is used, the cathode bias is obtained from the bleeder resistors R33, R34, and R101B. The resistor R101B is variable to allow change of the receiver sensitivity. When automatic volume control (AVC) is used, the switch S102 shunts the resistor R101B to ground. Decoupling, RF filter or dropping resistors are used in each of the high voltage leads to the tubes.

2-1-2-2. Antenna Connections

When the receiver is used for reception on any of the four bands the ganged band selector switch S1 selects the primary coil to be used.

When using the conventional straight wire antenna, the selected loop primary coil of transformers T1 or T2 is provided with an artificial load (L1 and C1) representing the normal inductance and capacitance of the rotatable loop. This compensation is necessary to insure that the tracking curve remains normal.

2-1-2-3. RF Circuits

The desired secondary coil (transformers T1 to T4) is selected by the band selector switch S2 and tuned by the ganged capacitor C12A. The tuned signal is fed to the grid of the tube V1 where it is amplified. Switches S3, S4 connect the desired transformer (T5 to T8) to the ganged tuning capacitor C12B, thus coupling the tuned and amplified signal to the control grid of the mixer-heterodyne oscillator tube V2. The heterodyne oscillator circuit comprises the triode section of V2 and the oscillator can assembly. This assembly houses the oscillator coils, their trimmers and padder capacitors, and the band selector switches S5 and S6. See Section 2-1-2-11 for operation of crystal controlled oscillator. The ganged tuning capacitor C12C always tunes the oscillator circuit to a frequency 1630 Kcs above the frequency of the incoming signal, the output of the triode oscillator section being mixed with the incoming signal in the tube V2. The voltages resulting from the combined signals are fed to the intermediate frequency transformer T13, which attenuates all but the desired beat, or 1630-Kcs difference frequency.

2-1-2-4. Intermediate Frequency and Second Detector Circuits

The voltage obtained from the IF transformer T13 is tuned and amplified by the two IF stages V3, T14, and V4, T15. The output of the transformer T15, is rectified in one diode section of the tube V5 (socket terminal 5).

The audio frequency component of this rectified signal voltage appears across the diode resistors R20, R22, which are connected in series. A portion of this voltage is taken off at the junction of R20 and R22, and is fed to the control grid of the triode section of tube V5 to be amplified.

2-1-2-5. CW Oscillator Circuit

Output from the continuous wave (CW) beat frequency oscillator, V6, is coupled to the grid of V4 through capacitor C49. Operation of the tube V6 is controlled by S102 the CW-MVC-AVC switch located on the remote control unit.

2-1-2-6. Automatic Volume Control Circuits

The DC component of the rectified signal voltage appearing across the diode load resistors R24, R25 is supplied to the AVC bus that feeds the grids of the tubes V1, V2, and V3. Interaction between tubes is eliminated by using a filter in each grid lead. When the control switch S102, designated CW-MVC-AVC, is in the AVC position, the AVC voltage is applied to the grids of the tubes V1, V2, V3; the variable resistor R101B and the cathode bias bus is shunted to ground thereby providing fixed cathode bias and predetermined receiver sensitivity; and the headphone jacks J101, J102 are shunted across the variable portion of the resistor R101A, permitting variable limitation of the audio signal. When in the MVC position, the switch S102 performs the following functions: The resistor R101B controls the receiver sensitivity, and the phone jacks J101, J102 are shunted across the resistor R101A, which has its variable arm disconnected.

2-1-2-7. Automatic Signal Limiter Circuit

Overloading or blocking of the receiver under very high signal inputs (signals up to 2.5V) to the antenna when the receiver is functioning on AVC, can be prevented by inserting a type 6H6 diode rectifer tube in the vacant V9 socket under the chassis. This tube may be inserted without changing any part of the circuit due to the fact that the necessary connections to the socket have been incorporated in the receiver. However, it will be necessary to retrim the high end of each band by adjusting the trimmer condensers C6, C7, C8, and C9 of Bands 1, 2, 3, and 4 respectively, in the antenna stage only.

It will *not* be necessary to change the inductance adjustments on the coils for only the distributed capacitance of the circuit has been changed by inserting the type 6H6 diode rectifier. The diode is so biased that it does not start to load the circuit until a signal of approximately 1/4V is impressed at the antenna binding post. In no way does this lessen the sensitivity of the receiver for signals below 1/4V inputs. Due to the low impedance of the diode rectifier to the high impedance tuned circuit, especially at the lower frequencies the rectifier tends to compress the modulation peaks on radio telephone signals. The effect of this is to cut down the percentage of modulation. However, this is noticeable only at the lower frequencies (below 2000 Kcs), and then only with signal input voltage between one-quarter and one volt. At such high signal input voltages, the signal-to-noise ratio is very great, and, in practice, the decrease in modulation is not objectionable. Such sacrifice in modulation capability is more than offset by the advantage gained in the ability of the receiver to handle signal input voltages to 2.5 volts with automatic volume control without overloading.

However for beacon reception on the beacon band (Band 1) *the limiter should not be used* because of the non-linearity between input and output of high signal inputs (above one-quarter volt on the antenna), caused by the demodulation effect of the diode rectifier. *This in effect causes an apparent reversal of the beacon signals.* When the limiter is used, the receiver *will no longer* carry the Civil Aeronautics Authority approval as outlined in section 1-4-1.

Without the signal limiter, the receiver will withstand up to three-quarters of a volt on the antenna without serious distortion when functioning on AVC. There will not be more than 2 DB decrease of audio output power for any increase in signal input at the antenna binding post within the range of 5 microvolts to 2 volts, and for any setting of volume control or with the function switch on either AVC or MVC.

2-1-2-8. Audio Circuits

As previously stated, intermediate frequency voltage is detected in one diode section of the tube V5 and the audio component of the signal appears across the diode resistors R20, R22. The audio voltage obtained at the junction of R20 and R22 is amplified by the triode section of V5 and fed through coupling capacitor C72 and contacts of the side-tone circuit relay K2 to the tubes V7 and V8. The audio signal is amplified by these tubes. The output of V7 is fed to phone jacks J101, J102 through the tapped audio transformer T16. When AVC is used, the resistor R101A controls the audio output. When manual volume control is used, the resistor R101B is connected into the RF circuits controlling the receiver sensitivity, and the audio output varies only as the receiver sensitivity is varied.

Relay K3, which is energized when the receiver is changing bands, shorts the grids of V7 and V8 to ground, thus silencing the receiver during band change.

The output of V8 is fed through the tapped audio transformer T17 to the junction box. This second audio output circuit may thus be wired to any remote point in the plane.

2-1-2-9. Side-Tone Circuit

A portion of the audio voltage from a transmitter may be fed to the audio input circuit of the receiver for purposes of monitoring transmissions. Relay K2 is connected into the grid circuit of the audio amplifier tubes V7 and V8 to allow input from either the receiver circuits or the transmitter side-tone circuits. The unoperated or normal position of the relay provides continuity of the receiver output circuits. The operated position of relay K2 connects the externally applied voltage, (approximately 1 to 5 volts) to the amplifier tubes V7 and V8. Voltage for operation of the relay is obtained from the primary source at the junction box. The relay is controlled by connecting the transmitter push-to-talk switch to the negative and positive side-tone leads. All connections to the side-tone relay circuits are to be made in the junction box as shown in Figure 20.

2-1-2-10. Band Change Circuit

Band changing is effected by switching the tuned circuits in the RF, first detector, and heterodyne oscillator stages by means of motor-driven switches. The motor armature drives a worm gear which is ganged on a common shaft with the crank arm and locking cam, the control cam, switches S7 and S8, and the RF band change switches. When the remote control unit band selector switch S101B is operated to select a different band, the band switch motor B1 is energized by completing the circuit to ground through the contacts of S101B and S7. The motor drives the crank arm through one or

more complete revolutions depending upon the band selected, whch steps the Geneva disc until the motor is de-energized by the opening of S7, which is on the same shaft as the Geneva disc and the switches that select the tuned circuits. Exact control of the positioning is obtained by the cam-operated switch S8. When the motor is at rest, the arm of the switch S8 is on step 2 of the control cam, and all contacts are open. When the motor starts, the arm is first raised by step 3 of the cam, closing the outside contacts, which at this time perform no function since the corresponding contact of S101B will be open. As the motor continues operating the arm of S8 will drop to step 1 of the cam, opening the upper contacts and closing the lower ones. The closing of the lower contacts provides an additional path to ground to keep the motor energized after the opening of S7 by the movement of the Geneva disc. When the crank arm has been driven past the Geneva disc, engaging the locking cam with the arc of the disc, the control cam raises the arm of S8 to step 2, opening all contacts, and the motor coasts to a stop. If it should coast past step 2, the upper contacts of S8 will be closed by the contacts of S7 and S101B and the motor will reverse to the proper position until all contacts of S8 open.

2-1-2-11. Crystal Oscillator Circuits

A. Lock-In Crystal Controlled Circuits.

Provision is made for the addition of one lock-in crystal-controlled frequency in each of two bands. The Type RA-10C, RA-10D, RA-10CD and RA-10DD Receivers are provided with a built-in crystal socket and the necessary wiring. To use the crystal lock-in feature, it is necessary to obtain a mounted crystal 1630 Kcs higher in frequency than the frequency of the desired signal (Type MX-9E). With the switch S102A turned to XTAL, lock-in occurs over a band width of at least 40 Kcs. This lock-in is unsymmetrical, that is, when approaching the crystal-controlled frequency from a lower frequency, lock-in occurs at a point 10 to 15 Kcs below the crystal-controlled frequency; when approaching from a higher frequency, lock-in occurs at a point 30 to 35 Kcs above the crystal-controlled frequency. With the switch S-102A turned to LOOP or XTAL, normal reception (general coverage) is obtained.

B. Fixed Frequency Crystal Controlled Circuits

When fixed frequency operation is desired in Bands 3 and 4 or 1 and 3, the circuits must be altered. Therefore, it is preferable that the necessary information be included in the purchase order.

Briefly the changes consist of substituting fixed tuning capacitors in all tuned RF circuits in place of the variable gang capacitors on the crystal controlled bands. These capacitors must be selected to tune the coils to the frequency specified. This fact and the fact that considerable wiring changes are necessary make this conversion definitely a factory operation. The necessary changes for fixed frequency operation are indicated in dotted lines on Figure 20.

2-2. TYPE MR-9BB AND TYPE MR-9CB REMOTE CONTROL UNITS

All normal tuning and operating adjustments are made from the remote control unit, no provision being made for local operation at the receiver. The base is designed to be fastened securely to the airplane at any location which is accessible to the pilot. The case of the remote control is made of aluminum and has its exterior surfaces finished with grey wrinkle-enamel. The case, which carries all parts, may be removed from the base by unfastening the 3 holding screws. The following controls are located on the front panel, see Figure 5.

The TUNING control, located in the lower left corner of the unit, provides for the selection of the desired frequency on any of the four bands. This control is connected to the receiver variable capacitor by means of a flexible tuning shaft. A dial on this control is directly calibrated in kilocycles on the two low frequency bands and in megacycles on the two high frequency bands. The dial is illuminated by means of an aircraft instrument lamp which is readily replaceable when in flight. A SPARE LAMP is mounted on the remote control unit.

The BAND SELECTOR switch S101, located below the tuning dial port, energizes the band selector motor, thus selecting any one of the four bands, see Section 2-1-2-10. A mask, attached to the switch shaft, permits viewing only that part of the tuning dial associated with the selected band. The frequency limits of each band are etched on the panel adjacent to the index marks.

The A.V.C.-M.V.C.-C.W. switch S102 selects the following functions: A.V.C. (automatic volume control action) M.V.C. (manual volume control) C.W. (for reception of continuous wave signals). A.V.C. action is available on all bands.

The OFF-VOLUME control, S104-R101A-R101B, adjusts the signal output or receiver sensitivity as determined by the setting. Switch S104 connects the power input to the receiver low voltage circuits at all settings of this control except OFF. With the switch S102 in the A.V.C. position, potentiometer R101A in the headphone circuit varies the signal output. With the switch S102 in the M.V.C. or C.W. positions, the signal output is determined indirectly by potentiometer R101B, which varies the receiver sensitivity.

The OFF-LOOP-XTAL switch S102A connects the crystals into the receiver heterodyne oscillator circuit in the XTAL position. In the LOOP position the loop antenna is in use, and in the OFF position the non-directional antenna is in use. (See Section 2-1-2-11).

The protective FUSE is mounted on the remote control panel and is readily accessible for replacement. This fuse is connected in the positive primary power supply lead.

The Types MR-9BB and MR-9CB Remote Control Units are similar except for the fact that the Type MR-9BB provides a 600-ohm output circuit, while the Type MR-9CB provides a 4000-ohm output circuit.

All external connections to the remote control unit are made to jacks or receptacles located on the lower surface of the control box. These connections, viewed from left to right, are: coupling for the flexible shaft that controls receiver tuning; plug receptacle J2 for connection of the electrical cable that joins the remote control to the junction box; and phone jacks J101 and J102 for connection of the headsets.

2-3. TYPE MS-14B JUNCTION BOX

All interconnections between the various units are made in the junction box. This box is supplied with 8-32 screw type terminals. As the location and size of cable entering holes will be dictated by the requirements of the particular installation, these junction boxes are furnished undrilled except when the needed information is included with the sales order. The schematic diagram, Figure 20, shows interconnections between the various units.

2-4. TYPES MN-20E, MN-24C ROTATABLE LOOPS AND MN-46B FIXED LOOP

A rotatable loop is used when the components listed in Sections 1-2-1 and 1-2-2 are operated as an aural-null direction finding or anti-static radio receiver equipment. A fixed loop is used for aural-null homing.

The loop consists of a low-impedance, center-tapped coil enclosed in an electro-static shield. At the top of the shield is a gap which is insulated and waterproofed. The loop is permanently fastened into its mounting base. In the case of the rotatable loop the necessary gears for turning the loop to any desired position are provided in the base. Rotation of the loop is accomplished by means of a tuning crank on the azimuth control which is coupled to the loop through a standard flexible tuning shaft. The loop may be supplied with either a straight tuning shaft fitting or a right angle fitting MS-52A so that tuning shaft may leave the loop at various angles. See figures 10 and 11 for details. In the case of the Type MN-46B Fixed Loop there is only a fixed wire connection to the loop transmission cable receptacle, there being no necessity for slip ring connections or a tuning cable.

2-5. TYPE MN-52JA AZIMUTH CONTROL

The azimuth control may be mounted in any convenient position near the pilot or radio operator. It is provided with an azimuth scale and pointer for the purpose of indicating the setting of the loop with regard to the heading of the aircraft. An instrument lamp is provided for the purpose of illuminating the scale; switch S303 provides on-off control of this lamp. A switch S301 is provided for the purpose of selecting receiver input from either the sensing antenna or from the rotatable loop antenna. This switch operates the loop antenna selector relay K201 in the Type MR-11C or MR-11D Loop Relay Unit to perform these functions.

2-6. TYPE MN-40D AZIMUTH INDICATOR

Essentially, the Type MN-40D Azimuth Indicator consists of a double-ended tuning shaft

drive to which is connected, through an appropriate gear and cam drive, a pointer which moves over the azimuth scale, two 3-volt lamps and an internal dropping resistor which may be changed to provide operation on either 14 or 28 volts.

The cam strip is located in the cam housing assembly and is provided with an adjusting screw (through the cam housing assembly) at each 15 degrees around its periphery. The compensator which is controlled by this cam strip automatically applies the aircraft error correction to the indicator pointer. The scale which is visible through the small opening in the lower center of the indicator face is used as a reference scale when the aircraft error compensators are being adjusted.

The heading of the aircraft relative to magnetic North, and any necessary East or West variation correction is applied by moving the azimuth scale the proper number of degrees relative to the fixed index mark by means of the variation knob.

Quadrantal error correction is accomplished by adjusting the cam screws. As supplied, the cam adjusted screws introduce no correction.

2-7. TYPE MR-15A CRANK DRIVE

The Type MR-15A Crank Drive when coupled by means of a mechanical cable to the azimuth indicator Type MN-40D is used to rotate the indicator and the loop. The mechanical cable may be coupled to either of two pinions depending upon the desired direction of rotation in relationship to loop and indicator rotation.

The unused pinion is protected by a cap which is equivalent to the coupling nut of the mechanical cable.

The Type MR-15A Crank Drive is not used when the Type MN-52JA Azimuth Control is used because the loop and azimuth pointer driving mechanism (crank operated) is provided as a built-in part of this unit.

2-8. TYPE MR-11C AND TYPE MR-11D LOOP RELAY UNIT

The Type MR-11C Loop Relay Unit is supplied only when the Type RA-10C or RA-10CD Receiver is equipped for aural-null direction finding, the Type MR-11D Loop Relay Unit is supplied with the Type RA-10D or RA-10DD Receiver; see Section 1-2-2. This unit is mounted on the front of the receiver by means of three captive mounting studs. Its outer surfaces are covered with grey wrinkle-enamel. The loop relay unit contains a plug socket J3 for connecting the loop transmission cable into the unit, an antenna binding post for connecting a sensing antenna, and a relay for the purpose of selecting input from the desired antenna. This relay is controlled by a switch S301 on the Type MN-52B Azimuth Control or switch S102A on the Type MR-9BB or MR-9CB Remote Control Unit.

See Section 3-3-7 for details of mounting and interconnection.

2-9. 28-VOLT EQUIPMENT DIFFERENCES

The Types RA-10D and RA-10DD Aircraft Radio Receiving Equipments (28-volt) are essentially the same as the Types RA-10C and CD Aircraft Radio Receiving Equipments (14-volt) previously described, the differences resulting from the change of primary voltage only. Following is a list of the differences in the two equipments: (See Section 7, and Figure 20 for part numbers and details).

Item	*Symbol*	*RA-10C and RA-10CD*	*RA-10D and RA-10DD*
Dynamotor	D1	14V Input	28V Input
Motor	B1	14V Input	28V Input
Relay	K1	14V Coil	28V Coil
Relay	K2	R32 Shunted	R32 in Series
Resistor	R35	Not used, Shunted	120 Ohms
Resistor	R36, R37	61 Ohm section (R36) used, 71 Ohm section (R37) shunted	132 Ohm, Total; Shunt removed
Resistor	R38	Not used	125 Ohms
Resistor	R39, R40	25 Ohm section (R39) used, 150 Ohm section (R40) shunted	175 Ohm, Total; Shunt removed from R40
Filament Circuits		Connect jumpers from B to C to D, and E to F	Connect jumpers from C to G, and D to E
Resistor	R103	61 Ohm section used, 71 Ohm section shunted	132 Ohm, Total; Shunt removed
Relay	K201	14V Coil	28V Coil

3. INSTALLATION

3-1. PRELIMINARY INSPECTION

Prior to the installation of any equipment, a thorough visual and, if possible, electrical inspection of all parts should be made in accordance with the procedure listed in Section 4-1.

3-2. BONDING AND SHIELDING

The ultimate sensitivity of any aircraft receiving installation is limited by the magnitude of the local electrical interference, rather than by actual sensitivity of the receiver as measured in the laboratory. If reception of weak signals is desired, the aircraft engine, charging generator, ignition system, and all electrical accessories must be completely bonded and shielded prior to installation of the equipment.

3-3. LOCATION AND MOUNTING OF RADIO RECEIVING AND DIRECTION FINDING EQUIPMENT

See Figures 9 through 19 for mounting dimensions.

3-3-1. TYPE RA-10C, RA-10D, RA-10CD AND RA-10DD RECEIVERS

The mounting base that supports the radio receiver should be firmly attached to a plane surface at a point within the shortest practicable distance from the vertical antenna lead-in, and in close proximity to the associated equipment. When determining this location care must be taken to choose one that will permit the radio receiver to vibrate freely in all directions without striking any other equipment or portions of the airplane. After these requirements have been met and the lower mounting base has been permanently secured, the upper mounting base, which is permanently fastened to the bottom section of the receiver case, should be attached to it by means of the Dzus fasteners. (See Figure 9).

3-3-2. TYPE MR-9BB AND TYPE MR-9CB REMOTE CONTROL UNITS

The Type MR-9BB or MR-9CB Remote Control Unit should be located where the panel will be easily visible and the controls accessible to the operator. Consideration must be given to providing clearance for connection of the mechanical tuning shaft and the electrical cables. (See Figure 15).

3-3-3. TYPE MS-14B JUNCTION BOX

The junction box should be mounted in an accessible location. In the interest of weight reduction of interconnecting cabling, it is well to locate this box as near as possible to the component units. The junction box will require cable fitting holes suitable to the individual installation. (See Figure 18).

3-3-4. TYPE MN-20E, TYPE MN-24C ROTATABLE LOOPS OR THE TYPE MN-46B FIXED LOOP

The loop must be mounted within a 6 to 12 foot cable run of the receiver and should be as far removed as possible from antennas and interfering metal structures. The preferred locations are on the fore-and-aft center line of the ship, either above or below the fuselage, about where the wings are attached. The MN-46B Fixed Loop must be mounted on this fore-and-aft line and the plane of the loop must be at right angles to this fore-and-aft line, i.e., the center of this loop is on the fore-and-aft line and the flat sides of the loop are to the fore-and-aft.

A mounting plate for the loop (either of the three types) should be drilled as shown in figures 13 and 14, and secured to the aircraft structure in such a manner that the loop base will be level during normal flight. Holes should be made in the skin of the aircraft to permit passage of the rotator mechanism (types MN-20E and MN-24C), the loop transmission cable, and the securing screws. Sufficient clearance should be available inside the fuselage for the attachment and removal of the cables. A Type MS-52A Right-angle fitting may be used for the tach shaft if necessary. A velutex, or similar gasket should be used between the loop mounting base and the skin of the aircraft to make a water-tight seal.

The Type MN-20E or the Type MN-24C Rotatable Loop may be mounted on the top or bottom of the ship. The only difference between the two mountings lies in the choice of tach-shaft couplings found on the bottom of the loop base. The selection of the correct tachshaft coupling to use with the various types of azimuth indicator and control installations is shown in figure 19.

3-3-5. TYPE MN-40D AZIMUTH INDICATOR AND TYPE MR-15A CRANK DRIVE

The azimuth indicator should be mounted so that the dial is easily readable from the opera-

tors position with a minimum of parallax. Figure 17 shows the mounting dimensions for the Type MN-40D Azimuth Indicator and the MR-15A Crank Drive. To enable mounting the azimuth indicator in that position which facilitates the approach of the tachshafts and still retain indications relative to the ships heading, the zero positions of the dials may be shifted to any of four 90-degree separate positions. This change of position may be accomplished by removing the snap ring and glass, removing the eight dial holding screws and rotating the dial to the desired position. When replacing the screws, use a small amount of glyptal cement to hold them in place. Such a shift in the zero position of the dial will necessitate resetting of the cam strip. The mechanical cable must be attached to that azimuth indicator pinion which causes the pointer to rotate in the same direction as the loop (see figure 19).

Two instrument lamps have one side ground and a single wire cable to supply power to these lamps. Internal dropping resistors permit these 3-volt lamps to operate from the aircraft power source. The indicator is supplied normally for 14-volt operation unless the stencilling on the unit states otherwise. However, another resistor supplied in a cloth bag attached to the indicator may be used to replace the one already in the unit for 28-volt operation.

Mount the Type MR-15A Crank Drive where it is convenient to the operator. Figure 17 shows the mounting dimensions. Also see figure 19.

3-3-6. TYPE MN-52JA AIZMUTH CONTROL

The Type MN-52JA Azimuth Control is arranged for mounting on a flat horizontal or vertical surface in front of, or beside the pilot. (See Figure 16).

3-3-7. TYPE MR-11C OR MR-11D LOOP RELAY UNIT

The loop relay unit is designed to be mounted on the front panel of the receiver. On the etched panel of the receiver will be seen three small marks coinciding with the location of the three mounting screws of the loop relay unit. Fastened into the case behind these marks are tapped inserts that hold the loop relay unit mounting screws (the etched panel must be drilled at the marked positions, care being taken not to injure the inserts behind the panel mask).

The procedure for mounting and wiring the loop relay unit is as follows:

A. Remove the receiver antenna binding post and connection to the ANTENNA terminal on the antenna can assembly.

B. Drill three holes through the receiver etched panel at the marked positions with a No. 16 drill.

C. Pull the seven leads from the loop relay unit through the hole formerly occupied by the antenna binding post.

D. Fasten the loop relay unit to the receiver with the three mounting screws supplied with the relay unit.

E. Remove the connection between the dummy loop coil L1 and the LOOP #1 terminal on the antenna can assembly, then connect the White-Blue (RF Insulated) wire, in the cable, to the same side of the dummy loop coil L1 on which the jumper to LOOP #1 terminal was just removed.

F. Remove the connection between the dummy loop coil L1 and ground, leaving the connection to LOOP #2 terminal on the antenna can assembly.

G. Connect the White-Blue (RF Insulated) wire to the LOOP #2 terminal on the antenna can assembly.

H. Connect the Black wire to ground.

I. Connect the White-Red-Green (RF Insulated) wire to the ANTenna terminal on the antenna can assembly.

J. Connect the White-Blue (Glass Insulated) wire to the +A end of R39.

K. Connect the Brown-Yellow wire to contact 3 also on the cable receptacle J1.

3-4. CABLE CONNECTIONS

The equipment and cables must not interfere with the airplane controls nor with other instruments or equipment.

The cable conduit and flexible tuning shaft should be securely fastened in place wherever necessary to prevent abrasion or vibration. Cables connecting to the receiver should be unsupported for a distance of two feet from the unit and should have enough slack left so that they will not interfere with the action of the shockmounting. The loop cable should be insulated with friction tape wherever it touches another metallic surface. Cables should be cut to the desired length by the customer. All connections are to be made as shown on Figure 21 or 22. The loop transmission cable should not

be cut, any excess length may be coiled wherever convenient.

The flexible tuning shafts should be bonded to the principal metallic structure of the aircraft at frequent intervals. The minimum bending radius of the tuning shafts is six inches and not more than two six-inch 90-degree bends should be made in any one cable installation. Several bends of larger radius or greater angles may be permitted however. The ends of the shafts terminate with spline joints which are securely held in place on the units by threaded collars.

A gear box mounted on the front panel of the receiver provides means for obtaining the necessary reduction of rotation between the flexible tuning shaft and the tuning capacitor. The flexible shaft connects through a spline and shaft to a worm gear which drives a split, spring-loaded, spur gear. This gear is provided with stops to limit the amount of rotation to 180°. The hub of the spur gear is tapered to fit a similar taper on the gear shaft, pressure for locking the gear to the shaft being provided by a knurled nut. When this knurled nut is loosened, the shaft may be turned to any setting without turning the gears. An arm that engages the tuning capacitor is mounted on the end of this gear shaft.

The gear box assembly may be mounted at any one of 12 positions on the front panel in order to run the flexible tuning shaft to the unit in the most desirable direction and in such a way that any sharp bends may be eliminated. If it should be desirable to change this gear box position, the following instructions should be followed.

A. Connect the tuning shaft and the remote control to the gear box and rotate the tuning crank in a counterclockwise direction until the gear box stops prohibit further rotation. *Be sure that the condenser is not forced against its stops.*

B. Disconnect the tuning shaft from the gear box and remove the three screws holding the gear box to the receiver, and remove the gear box cover.

C. Loosen the knurled nut in the gear box.

D. Be sure that the capacitor is set as maximum capacitance.

E. Rotate the gear box to the desired position and fasten it in place on the receiver.

F. Make certain that the capacitor is turned to maximum setting, then tighten the knurled nut, and replace the cover plate.

G. Turn the remote tuning crank until the finish line at the low frequency end of any band on the dial scale is centered under the window index line.

H. Reconnect the flexible tuning shaft and check the adjustments by rotating the tuning crank throughout its range to see if minimum and maximum capacitances are obtained at the end points of the dial scale. When the capacitor drive strikes the stops in the counterclockwise direction the capacitor should be fully meshed and the low frequency end marks should be under the window index. However, in the clockwise direction the stop may come slightly beyond the end marks due to variations in stops.

The flexible shaft which links the loop antenna and azimuth control should be connected so that the plane of the loop is at right angles to the airplane line of flight when the dial reading is zero. After setting the two units, tighten the shaft securely and check the installation by rotating the azimuth control knob several degrees each way, then resetting to zero. If the mechanical cable has been properly aligned, the dial scale will read zero when the plane of the loop is at right angles to the line of flight.

3-5. ANTENNA TYPES AND CONNECTIONS

The Type RA-10C, Type RA-10D, Type RA-10CD and Type RA-10DD Receiver Units are designed and adjusted to operate in conjunction with a vertical antenna having an effective height of 0.1 to 0.6 meters, a capacitance between 50 and 150 Mmf, and a resistance of 1 to 10 ohms. While it is desirable to use an antenna whose characteristics fall within the above limits, satisfactory operation may be obtained with other antennas.

The type of antenna which will be used in any particular installation will be dictated by consideration of space and support structures available on the aircraft.

The portion of the lead-in inside the fuselage should be flexible insulated wire. A suitable amount of slack must be allowed at the receiver to permit free action of the shockmounting.

4. PREPARATION FOR USE

4-1. TEST BEFORE INSTALLATION IN AIRCRAFT

Considerable time and trouble will be saved if the components of the radio receiving or direction finding equipment to be installed in an airplane are interconnected as shown in Figures 21 or 22, and tested before installations. The components should be properly interconnected and tested as follows: Tune in several radio stations in each band. On each station operate the equipment both as a receiver and as a direction finder. Check operation of AVC, MVC, and CW. Check operation of crystal lock-in oscillator if the equipment is so supplied. From a knowledge of the distance, power, and direction of the station a rough check may be obtained of the performance of the equipment.

These tests should be made in a frame testshack in an isolated spot free from electrical interference and at least 200 feet distance from large electrically conductive objects such as buildings, hills, power lines, railroads, etc. *Bearing accuracy checks cannot be relied upon if made inside or close to buildings with metal structures or large electrically conductive objects* unless the direction finder bearings check actual geographical bearings.

The following inspection should be made prior to installation.

A. Check list of parts and see that all parts are in good condition.

B. Insert all tubes in the radio receiver, making sure that they are firmly seated in their respective sockets and that all grid clips are pushed down tightly.

C. Check safety wiring of dynamotor.

D. Check all lamps and fuses.

E. Check operation of tuning drives and all controls for freedom of operation.

F. Allow the equipment to operate for at least one-half hour. Check operation of headset. Vibrate or jar the equipment. Any clicks or increase in noise will require a thorough investigation and removal of the cause. Improper soldering of wires to the plugs and noisy vacuum tubes are the usual sources of trouble.

G. If the equipment does not seem to be operating satisfactorily, the interconnecting leads and vacuum tubes should be rechecked and equipment known to be operating substituted for the faulty component.

4-2. TESTS AFTER INSTALLATION

After the components have been installed in the aircraft, the following tests should be made before placing the equipment in service.

A. Before turning on the receiver, check the battery voltage and polarity at the remote control. The fuse terminals should be +11 to +15 volts (22 to 30 volts for 28-volt installations) with respect to ground, regardless of engine speed.

B. Check the vacuum tubes to ascertain that they are securely seated in their sockets and that the grid clips and grid shield caps are making positive contact and are not shorting.

C. Test the operation of mechanical cables and the connections at both local and remote positions. When properly connected, the low frequency end mark on the remote dial is centered with the window index when the ganged capacitor is at maximum.

D. Check the receiver mounting base screws.

E. Check the remote control for tightness of mounting to aircraft structures, and check mounting screws on panel for tightness.

F. Check the fixed antenna and see that the connections are properly and securely made.

G. Be sure that the loop transmission cable is supported, taped, and bonded. Check tightness of ferrule couplings on the plugs.

H. Check for presence and operation of instrument lamps.

I. Using a headset, check receiver and direcfinder operation of all bands, jar the receiver to check for possible sources of noise.

J. Switch the power on and off and note whether or not the magnetic compass is affected.

K. Check for effects of other radio equipment in the aircraft upon the communicational and navigational performance of the Model RA-10 Receiving Equipment. Also determine the extent of any interference produced by this receiver in other radio equipment.

L. With the VOUME control at maximum, tune through each band with the engine stopped, and note the noise level. Repeat

the test with the engines running at various speeds. If any appreciable increase in noise is noted with the engines running at any speed, the aircraft shielding and bonding and the battery circuit filtering should be improved.

4-3. DIRECTION FINDING DEVIATION

Practically all aircraft direction finding installations give definite errors in relative bearings which vary in a regular pattern throughout the 360 degrees, and are known as quadrantal errors or quadrantal deviation. These errors are caused by the effect of the metallic fore-and-aft-mass of the fuselage structure, the athwartship mass of the wing structure, and the effect of closed circuits such as represented by wing bays, in the case of biplanes, or braced monoplanes. If the loop is mounted on the exact centerline of the airplane and the connection to the azimuth control has been properly aligned, there is generally no appreciable error on bearings taken dead ahead (0°) or astern (180°). Advantage may be taken of this condition, when exact bearings are desired before it has been possible to calibrate the installation, or to determine the exact reference bearing of a station for calibration purposes. It has also been noted, in most installations, that a radio direction finder is somewhat more sensitive to bearings over the tail than to bearings from ahead, due to a slight shielding action of the wing structure, if this is ahead of the loop. The poorest bearings are frequently obtained, in the case of biplanes, at angles of around 60 to 70 and 290 to 300 degrees, where these bearings pass through the outer wing struts. Since the deviational errors in unfavorable directions are generally on the order of 10 to 20 degrees, and often still greater, it is highly desirable to measure such deviations by swinging the ship, preferably on a compass rose, in a suitable location. The calibration data thus obtained are used to calculate the various deviations, which may then be transposed and plotted against indicated bearings to form a correction curve. By correction, is meant that value which, when algebraically added to the indicated radio bearing, relative to ship's heading, gives the actual relative bearing of the incoming signal. Hence, if the actual bearing is numerically less than the indicated bearing, the correction is negative and is preceded by a minus sign and plotted below the zero axis; but, when the actual bearing exceeds the indicated bearing, the correction is positive, has a plus sign, and is plotted above the zero line. Correction is often confused with deviation, whereas the former term applies to the indicated while the latter refers to the actual relative bearings. They are numerically equal, but opposite in sign.

To perform the deviation calibration for plotting the correction curve, proceed as follows:

A. Visually check the loop, mechanical tuning shaft, and azimuth control alignment.

B. Select a suitable location for calibration, preferably a compass rose. This should be several hundred feet removed from high buildings.

C. Select a suitable transmitter upon which to calibrate. A local transmitter or broadcast station, preferably at a distance between one and ten miles is satisfactory. Its direction should be exactly known, or may be determined with fair accuracy by turning the airplane to give a zero bearing right over the nose. In absence of a suitable transmitting station, a fair calibration can often be made with a shielded radio-frequency driver provided with a vertical (metal rod or tube) radiator about ten feet high, and placed in the open at as great a distance as the location and receiver sensitivity permit—at least several hundred feet.

D. Tune in the calibrating signal as outlined in Section 5-4-1. Starting with a head-on bearing, swing the plane by five, ten or fifteen degree steps until a complete revolution has been made. For greatest accuracy, it is desirable to elevate the tail to approximately normal flight position as a fifteen degree fore-and-aft slope of the plane will result in one-degree bearing changes at certain loop positions.

E. For each 5- or 10-degree heading, record the following data:
   1. Actual magnetic heading, by compass rose or by corrected ship's compass.
   2. Indicated radio bearing, relative to ship's heading.

F. The deviation is calculated as follows:
   1. Add the plane's magnetic heading to the indicated radio bearing.
   2. Subtract 360 if the sum obtained in (1) permits.

3. If the result of operations (1) and (2) is more than the magnetic bearing of the station, subtract the magnetic bearing. The difference is the plus deviation. For example, if a certain transmitter has a magnetic bearing of 184 degrees, and the plane heading is 225 degrees, the indicated radio bearing might be 340 degrees. The sum as obtained under (1), is therefore 565; and since this is more than 360, we subtract, as in operation (2), obtaining 205. This result is more than the magnetic bearing of the station, so that the latter is subtracted from the former, as in (3), giving a deviation of +21 degrees.
4. If the result of operation (1) and (2) is less than the magnetic bearing of the station, subtract the result from the magnetic bearing. The difference is the minus deviation. Thus, using the same transmitting station, the magnetic bear- of which was 184 degrees, the indicated radio bearing might be 37.5 degrees when the plane heading is shifted to 135 degrees. The sum, as obtained for operation (1), is then 172.5; and since this is less than 360, operation (2) is omitted. However, the result is now less than the magnetic bearing of the station, so the former is subtracted from the latter, as in operation (4), and the deviation is —11.5 degrees.

G. In all cases, the desired corrections will be numerically equal to the deviations thus obtained, but opposite in sign. For example, a deviation of plus 10 degrees would require a correction of minus 10 degrees to the indicated radio bearing.

H. When all values for correction have thus been determined, plot the correction curve by showing plus corrections upward, minus corrections downward, and starting with 0 degrees indicated radio bearing at the left, ending with 360 degrees at the right side of the graph sheet. Connect the points by as smooth a curve as possible. If the calibration has been carefully performed, this curve will approximate a sine wave, having two peaks and two dips through the 360 degrees. If the peaks and dips are not about equal, or if the curve does not cross the zero axis at 0 degrees, 180 degrees and two intermediate points (approximately 90 degrees and 270 degrees), recheck the loop alignment and centering on the airplane, and verify the actual direction of the transmitting station as used in the calculations.

I. Repeat the calibration for different frequencies, as described. Do not fail to indicate the calibrating frequency on the different calibration curves thus obtained.

CAUTION: Any metallic masses, structures, or conductor in the field of the loop in which circulating RF currents may be induced, if later added, removed, or altered, may destroy the accuracy of the calibrations. This applies to the bonding of the airplane, relocation of wiring or of shielding, and spare parts or gear stowed near the loop. Check the calibration in flight at frequent intervals by taking bearings on stations of known direction. The corrected indicated radio bearing, added to the corrected magnetic heading, should give the actual magnetic bearing to the transmitting station (subtract 360 degrees if necessary).

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5. OPERATION

5-1. GENERAL

The switch located on the upper right hand portion of the remote control unit, marked C.W.-M.V.C.-A.V.C., provides the following functions:

C.W. position operates the beat frequency oscillator for reception of continuous wave signals.

M.V.C. position permits control of receiver sensitivity.

A.V.C. position permits control of audio output and the receiver sensitivity is at maximum.

The switch located on the upper left-hand portion of the remote control unit, marked OFF-LOOP-XTAL selects the type of operation. In the OFF position, straight receiver operation using the sense antenna is obtained. The LOOP position of the switch selects the loop antenna for direction-finding operation. The XTAL position places the crystals into the circuit for lock-in crystal control on bands 3 and 4 for Types RA-10C or RA-10D Receivers, or bands 1 and 3 for Types RA-10CD or RA-10DD Receivers.

The OFF-VOLUME control is a combined power on-off switch and volume control. When

turned to the maximum counterclockwise position, all current-consuming circuits are opened, thus rendering the equipment inoperative.

5-2. COMMUNICATIONS RECEPTION

5-2-1. GENERAL

The Type RA-10C, RA-10D, RA-10CD or RA-10DD Receiver Equipment may be used for normal reception of communications using a fixed antenna or, in times of extreme rain or snow static conditions, when provided with direction finding components, the loop antenna may be used in place of the sensing antenna for anti-static reception. Anti-static reception is not used at all times because of the lower overall sensitivity when using the loop antenna.

5-2-2. NORMAL RECEPTION (ANTENNA)

The operating procedure is as follows:

A. Turn the OFF-VOLUME switch clockwise.

B. Select the desired frequency range (Band 1, 2, 3, or 4).

C. Turn the C.W.-M.V.C.-A.V.C. switch to the desired position.

D. Tune in station.

E. Adjust VOLUME control for the desired signal level. See Section 5-2-4 for operation of the OFF-LOOP-XTAL switch.

5-2-3. ANTI-RAIN-STATIC RECEPTION (LOOP)

The operating procedure is as follows:

A. Turn the OFF-VOLUME switch clockwise.

B. Select the desired frequency range (Band 1 or 2).

C. Operate on C.W. or M.V.C. as desired.

D. Snap the ANT-LOOP switch on the azimuth control or the OFF-LOOP-XTAL switch on the remote control to LOOP.

E. Tune in station.

F. Rotate the azimuth control for maximum output in headset.

G. If the station is to the left or right of the airplane's course, it will occasionally be necessary to readjust the azimuth control setting for maximum signal.

H. Adjust VOLUME control for the desired signal level.

5-2-4. RECEPTION ON CRYSTAL CONTROLLED FREQUENCIES

5-2-4-1. Reception with Lock-In Crystal Oscillator

The operating procedure is as follows:

A. Turn the OFF-VOLUME control clockwise.

B. Select the desired frequency range (Band 3 or 4 for Types RA-10C or RA-10D; band 1 or 3 for Types RA-10CD or RA-10DD).

C. Turn the C.W.-M.V.C.-A.V.C. switch to the desired position.

D. Turn the OFF-LOOP-XTAL switch to XTAL.

E. Tune to within plus or minus 10 kilocycles of the desired frequency.

F. Adjust VOLUME control for desired signal level.

G. General coverage may be had by turning the crystal switch to XTAL OFF.

5-2-4-2. Reception with Spot-Frequency Crystal Oscillator (Bands 3 and 4)

The operating procedure is as follows:

A. Turn the OFF-VOLUME control clockwise.

B. Select the desired frequency range (Band 3 or 4).

C. Turn the C.W.-M.V.C.-A.V.C. switch to the desired position.

D. Turn the OFF-LOOP-XTAL switch to XTAL. However, the remote control unit may be wired to make this operation unnecessary.

E. Adjust VOLUME control for desired signal level.

5-3. HOMING

5-3-1. RADIO-RANGE RECEPTION

It is necessary either to have a map showing the radio-range course and characteristics, or to know the location of the course and its characteristic A and N signals area.

The operating procedure is as follows:

A. Turn the OFF-VOLUME switch clockwise.

B. Turn the band switch to Band 1 (150-400 Kcs).

C. Tune to the desired frequency.
D. Adjust the VOLUME control to the desired signal level.
E. Obtain a "fix" of position, see Section 5-4-3, thus determining the direction to the course it is desired to follow.
F. Turn the plane so as to intercept the radio range course. The A and N signals will blend into a continuous dash interrupted by the station identification when on-course.
G. The plane may then be flown on-course to the location of the radio range station.
H. Arrival at the destination is indicated by an abrupt decrease in headset volume which is due to entering the cone of silence.

NOTE: A radio-range course may also be flown with anti-rain-static reception, in which case the equipment is operated as described in Section 5-2-3.

5-3-2. AURAL-NULL HOMING

The operating procedure is as follows:

A. Turn the OFF-VOLUME switch clockwise.
B. Select the desired frequency range (Band 1 and 2).
C. Operate on C.W. or M.V.C. as desired.
D. Snap the ANT-LOOP switch on the azimuth control or the OFF-LOOP-XTAL switch on the remote control to LOOP.
E. Tune in station.
F. Rotate the azimuth control to zero if loop is of rotatable type. (The fixed loop, Type MN-46B is always at zero azimuth).
G. Turn the airplane until the headphone volume decreases to minimum.
H. Fly the plane on this null course until the desired position has been reached.

5-4. DIRECTION FINDING

5-4-1. AURAL-NULL BEARINGS (Rotatable loops only)

The operating procedure is as follows:

A. Turn the OFF-VOLUME switch clockwise.
B. Select the desired frequency range (Band 1 or 2).
C. Tune in station.

NOTE: When taking bearings of weak signals, it is helpful to use the CW oscillator beat note.

D. Adjust the VOLUME control to the desired signal level.
E. Rotate the azimuth control until the headphone volume decreases to minimum.
F. Observe the reading of the azimuth control dial which reading is relative to the airplane line of flight.
G. Observe the actual magnetic heading from the corrected ship's compass reading.

Correct the azimuth reading to the actual magnetic heading. Subtract 360 if the sum permits. The final figure will give either the true magnetic bearing of the transmitting station or its reciprocal, with respect to the position of the airplane.

5-4-2. DIRECTION FINDING PRECAUTIONS

When for any reason, broadcast station carriers are being used for obtaining bearings, care must be exercised in the selection of stations. Two stations operating on the same frequency may tend to indicate more than one direction, or may fail to give any indication of direction whatever. Stations operating on clear channels will always give the most satisfactory results. Note that broadcast transmitting stations are often situated a considerable distance outside of cities controlling them.

Night effect, or reflection of the radio wave from the sky is always present. It may be recognized by a fluctuation in bearings. The remedy is (1), increase altitude thereby increasing the strength of the direct wave; (2), take an average of the fluctuations; or (3), select a lower frequency station. Night effect is worst at sunrise and sunset. Night effect is present on stations at 1500 Kcs at distances greater than 20 miles. As the frequency decreases the distance increases until at 200 Kcs the distance will be about 200 miles. Satisfactory bearings however, will often be obtained at much greater distances than stated above.

5-4-3. POSITION FIX

A fix of position may be obtained by plotting two or more bearings on a map and observing the intersection of the bearings. An alternate method used when homing on a radio-range beacon requires only one bearing and the known direction of the radio-range course, the intersection of the two projected lines giving the location.

6. MAINTENANCE

6-1. LUBRICATION

The following parts require lubrication after the hours of service indicated below:

Part	*Time*	*Lubrication*
Dynamotor	1000 Hours	Royco No. 6A
Loop mounting gears and bearings	1000 Hours	Royco No. 6A
Receiver and remote control tuning gears and bearings.	1000 Hours	Royco No. 6A
Mechanical Tuning shafts.	As req'd	Royco No. 6A

Do not lubricate the variable tuning capacitor, potentiometers or dynamotor commutator. Band switch motor B1 is permanently lubricated and will not require attention, unless it is disassembled, in which case the bearings should be repacked with a low temperature grease such as *Royco No. 6A*. If the dial gear mechanism is disassembled, the ball bearings should be repacked with low temperature grease.

6-2. ROUTINE INSPECTIONS

6-2-1. PRE-FLIGHT INSPECTIONS

Regular inspections should be made preceding each flight as follows:

All interconnecting cables should be checked to see that they are securely locked in their receptacles.

Check the operation of the voltage regulator on the charging generator, adjusting same to insure consistant operation of the generators at the proper charging voltage.

Clean the antenna insulators, especially any which may be exposed to the engine exhaust or propeller blast.

Check connections of lead-in wires, both at antenna and receiver ends.

Check all instrument lamps.

If the receiver is functioning properly with the power supply background noise at a suitable low level, do not disturb the power supply unit.

Each inspection should include a listening test made on at least one point in each band. The operation of all controls should also be checked. Any major trouble should be apparent from these tests.

6-2-2. GENERAL PERIODIC INSPECTIONS

6-2-2-1. General - Applicable to All Parts

Inspect all nuts, bolts, and screws for looseness. Do not tighten or loosen glyptalled screws or nuts unless it is evident they are loose. In the event they are loose, remove screw or nuts, glyptal, replace and tighten. Remove loose solder, dirt, and metallic chips. Clean equipment thoroughly and touch up scratched paint. Inspect soldered joints. Inspect wiring. Inspect all plug connectors and clean if necessary.

6-2-2-2. Receiver

A. Inspect the unit as described in Section 6-2-2-1 but do not disturb the alignment adjustment. Do not disturb wiring unless necessary.

B. Check all tubes. If the tube plate current is less than 80% of normal plate current with 6.3 volts on the heater, replace the tubes. Replace all tubes used over 500 hours.

C. Dynamotor D1. The dynamotor should be inspected after 500 hours of service or once a year, whichever period is shorter. Examine the brushes to see if they have worn properly and are free of hard spots. If such spots are apparent, renew the brush. Spotted brushes can be located by inspecting the commutator for grooves. Remove the bearings from the armature, clean with penetrating oil and carbon tetrachloride. Check bearings for tolerances and broken or chipped balls. Clean away all old grease and relubricate. Wipe off dirt from the commutator, end bells, armature, and housing. If the commutator does not have a smooth, even surface, place the armature in a lathe and rotate it. Polish the faulty commutator with a piece of soap stone or take a very thin (.003-inch) cut using a lathe. Do not use sandpaper as this causes deformation of the commutator bars. *Do not use emery cloth.* Remove all dust and dirt particles after polishing. A commutator should have a smooth polished surface free of dirt, grease, or ridges. *A commutator having a smooth or polished surface should not be sanded or turned down simply because it is discolored.* Under normal conditions, the commutators should not require turning down before the expiration of

5,000 hours of service. After turning down, the commutator should be carefully examined to see if under cutting of mica is necessary. A small brush, such as a toothbrush, should be used to remove any foreign particles that remain between the commutator bars.

D. Tuning Mechanism. Remove all dirt and old grease. Lubricate the gears and tuning shaft coupling as specified in Section 6-1.

E. Tuning Capacitors. Inspect for dirt between plates. Carefully clean with pipe cleaner. Do not bend plates. Do not lubricate. Do not blow out with an air hose as the hose may contain water or the air pressure may bend the plates.

6-2-2-3. Remote Control Unit

Inspect as indicated in Section 6-2-2-1. Clean and lubricate the dial tuning mechanism and tuning shaft coupling as in Section 6-1.

6-2-2-4. Loop

Clean off all grease and dirt. Relubricate if necessary as specified in Section 6-1.

6-2-2-5. Test Performance

Reassemble the equipment and measure its performance as described in Section 4-1. Vibrate the equipment and note any increase in noise or clicks with and without RF input. If the equipment is noisy or fails to meet performance requirements, reexamine the equipment until the trouble is discovered.

6-2-2-6. Wiring

Inspect all bonding in the aircraft. Inspect the dynamotor safety wiring. Reassemble the equipment and safety wire it where necessary. Inspect the antenna lead-in. Inspect the loop mounting for proper bracing. Repeat the tests outlined in Section 4-2.

6-3. LOCATION AND REMEDY OF FAULTS

6-3-1. GENERAL

The locating of open and short circuit faults will be facilitated if, instead of testing at random points, an orderly procedure is followed. Using the schematic diagram for guidance, test one portion of a circuit at a time, and successively check each element contained in that portion for open circuits, short circuits, and grounds by measuring the resistance from point to point with an ohmmeter. If the measured values of resistance are normal, as compared with the resistance chart in Section 6-4-1-1, that particular portion of the circuit is probably not at fault and needs no further attention. The identifying symbols of all components are given on the schematic diagram and their normal values can be determined by reference to Section 7.

The following table lists the average signal input required at the grid of each of the amplifier tubes to produce a standard output of 50 milliwatts into a 500-ohm load or 4000-ohm load if equipment has been ordered for high-impedance output. In making these comparison measurements, the signal generator output should be connected from grid to ground. All measurements should be made on MVC, volume control at its maximum clockwise position, and the crystal switch turned off. For RF measurements, a signal of the specified frequency modulated 30% at 400 CPS should be used. A 400-cycle signal source is used in making AF measurements. Signal to noise power ratio of 4:1.

Tubes	*Band*	*Frequency*	*Input V for 50-MW Output*
V1	1	150 Kcs	4–8 Microvolt
V1	2	400 Kcs	4–8 Microvolt
V1	3	2000 Kcs	4–8 Microvolt
V1	4	5000 Kcs	8–15 Microvolt
V2	IF	1630 Kcs	25–50 Microvolt
V3	IF	1630 Kcs	1200–1700 Microvolt
V4	IF	1630 Kcs	40,000–60,000 Microvolt
V5	AF	400 CPS	150 MV
V7	AF	400 CPS	1.8 V
V8	AF	400 CPS	1.8 V

By comparing the receiver performance with these data, the location of operational faults will be greatly facilitated. It is recommended that the stages be checked in reverse order; i.e., V8 through V1.

6-3-2. NO SIGNALS

A. Test all tubes, using a tube checker. If a tube checker is not available, replace the tubes one at a time, allowing a sufficient period for each tube to reach the proper operating temperature.

B. If tapping the 2nd detector V5 introduces a ringing sound in the headset, the audio system is probably operating satisfactorily. If no sound is heard, check the primary and secondary of the output transformer for open circuits and grounds; also the associated circuit resistors and capacitors for open circuits and short circuits respectively.

C. Measure the plate, screen, and bias voltage at the tube sockets, referring to the table in Section 6-4-1-2 as a check on the measured value. If an abnormal voltage is found at any point, examine the associated resistors, capacitors, and coils for short circuits, grounds, and open circuits.

6-3-3. WEAK SIGNALS

A. Examine the antenna system for poor connections.

B. Follow the procedure outlined under Section 6-3-1.

6-3-4. NOISY RECEPTION

First determine whether the noise originates in the receiver or in some external source. To do this, disconnect the antenna from the receiver. If the noise is eliminated, examine the antenna system for loose connections and for points where rubbing against metal objects, etc. may occur. If shorting the antenna terminal to the ground terminal does not reduce the noise, check all cable bonding and look for loose connections throughout the installation. Check for noisy tubes following the procedure outlined in 6-3-2A.

6-4. SERVICING DATA

6-4-1. RESISTANCE-VOLTAGE ANALYSIS

6-4-1-1. Point-to-Point Resistance Measurements

The following table indicates the average resistance to be expected when measured from the terminals of the various tube sockets to ground with a sensitive ohmmeter. The receiver to junction box cable should be removed from its receptacle. Tubes should be left in their respective sockets.

Tube	*Socket Terminals*										
	1	*2**	*2†*	*3*	*4*	*5*	*6*	*7†*	*7**	*8*	*Cap.*
V1-RF Amp.....	0	0	0	45,000	7 Meg.	45,000	100,000	3	2	1,500	—
V2-Osc. Det.....	0	1	1	1,500	15,000	50,000	36,000	5	2	250	7 Meg.
V3-1st IF.....	0	1	5	45,000	2 Meg.	45,000	100,000	5	2.5	1,500	—
V4-2nd IF	0	0	2	300	2	300	100,000	5	2.5	1,500	—
V5-2nd Det.....	0	0	0	30,000	1 Meg.	1 Meg.	2 Meg.	3.5	2.5	3.000	500,000
V6-CW Osc.....	0	1	5	60,000	00	50,000	00	5	2.5	00	—
V7-2nd Audio.....	0	2	5	1,000	200	500,000	00	3	0	500	—
V8-2nd Audio.....	0	2	5	1,000	200	500,000	00	5	1	500	—
V9-Limiter.....	0	0	0	16	250	00	450	5	—	00	—

Rec. on Band 1.
*RA-10C or RA-10CD Receiver.
†RA-10D or RA-10DD Receiver.
00 Indicates infinity.

6-4-1-2. Tube Socket Voltages

All the typical measurements tabulated below were made with a 1000-ohm per volt DC voltmeter. The terminal voltage measured at the input of the battery cable was 28 or 14 volts. All measurements were made to ground except where noted. Equipment operating on MVC, crystal off, and the volume control turned to its

Tube	*Socket Terminals*						
	1	*2 to 7*	*3*	*4*	*5*	*6*	*8*
V1-RF Amp:	0	6.3V	2.2V	—	2.2V	55V	190V
V2-Osc. Det:	0	6.3V	190V	100V	—	95V	2.7V
V3-1st IF:	0	6.3V	1.8V	—	2.0V	55V	190V
V4-2nd IF:	0	6.3V	1.8V	—	2.0V	55V	190V
V5-2nd Det:	0	6.3V	125V	—	—	—	5.2V
V6-CW Osc:	0	6.3V	*5V	—	—	—	*0V
V7-2ndAudio:	0	6.3V	180V	215V	—	—	13V
V8-2ndAudio:	0	6.3V	180V	215V	—	—	13V
V-9-Limiter:†	0	6.0V	—	1.0V	—	190V	—

*CW Osc. operating.
†See Section 2-1-2-7.

maximum clockwise position. Filament and plate voltage may vary ±5%, screen and cathode voltage may vary ±10%.

6-5. RECEIVER ALIGNMENT

WARNING: DO NOT CHANGE THE SETTING OF ANY TRIMMER CAPACITOR UNLESS THE NEED OF SUCH ADJUSTMENT IS DEFINITELY ESTABLISHED. NO ADJUSTMENT SHOULD BE MADE, IN ANY CASE UNTIL THE FOLLOWING INSTRUCTIONS ARE CAREFULLY READ AND THE PROPER PROCEDURE THOROUGHLY UNDERSTOOD.

6-5-1. GENERAL

A. Signal generator (low output impedance), capable of 30% modulation at 400 CPS, accurately calibrated at the following frequencies:

150 Kcs	1100 Kcs	5000 Kcs
270 Kcs	1630 Kcs	7500 Kcs
400 Kcs	2000 Kcs	10,000 Kcs
700 Kcs	3500 Kcs	Kcs

B. Output meter. A 500-ohm low-impedance meter to be used if the receiver has a low-impedance output. A receiver with a high-impedance output should be adjusted with a 4000-ohm impedance meter. This meter may be bridged by a high-impedance telephone headset for monitoring.

C. Insulated aligning tool.

6-5-2. IF AMPLIFIER ALIGNMENT

Remove the grid lead of the converter tube V2 and connect the signal generator output to the grid through a .1-Mfd capacitor. Connect a 0.5-megohm resistor from the grid of V2 to ground, to furnish a bias return. Set the controls as follows:

A. Turn the OFF-VOLUME control fully clockwise.

B. Turn the function switch to M.V.C.

C. Turn the OFF-LOOP-XTAL switch to XTAL OFF.

Plug the output meter in one of the remote control phone jacks. Accurately set the signal generator to 1630 Kcs, and modulate the carrier 30% at 400 cycles per second.

Adjust the iron cores in the IF transformers T13, T14, and T15 for maximum deflection of the output meter.

Reset the signal generator frequency for a maximum deflection on the output meter and check the generator frequency. If it is other than 1630 Kcs, reset thereto and repeat the previously described alignment of the IF transformer iron cores. The input should be between 25 and 50 microvolts for an output of 50 milliwatts.

While the signal generator is at axactly 1630 Kcs, turn off the modulation and turn the function switch to C.W. Adjust coil L3 for zero beat. The CW oscillator will then oscillate at the IF frequency, and the zero beat method of aligning the RF oscillator stage may be employed. After completion of alignment, the CW oscillator should be readjusted to 1631 Kcs for the 1000-cycle per second difference frequency.

6-5-3. HETERODYNE OSCILLATOR ALIGNMENT

6-5-3-1. Trimmer Adjustment

Operate the receiver with the VOLUME control fully clockwise and with the crystal switch off. Plug a headset into one of the remote control phone jacks and couple the signal generator to the control grid of the first detector oscillator tube.

A. Turn on the CW oscillator, which has previously been adjusted to 1630 Kcs.

B. Set the signal generator to 400 Kcs output, unmodulated. Rotate the tuning dial to 400 Kcs on Band 1 and adjust capacitor C30 for zero beat.

C. Set the signal generator to 1100 Kcs output, unmodulated. Rotate the tuning dial to 1100 Kcs on Band 2 and adjust capacitor C31 for zero beat.

D. Set the signal generator to 5000 Kcs output, unmodulated. Rotate the tuning dial to 5000 Kcs on Band 3 and adjust capacitor C32 for zero beat.

E. Set the signal generator to 10,000 Kcs output, unmodulated. Rotate the tuning dial to 10,000 Kcs on Band 4 and adjust capacitor C33 for zero beat.

6-5-3-2. Padder and Core Adjustment (Low Frequency End of Bands)

With the equipment set-up as described in Section 6-5-3-1, padder and core adjustments are made as follows:

A. Set the signal generator to 150 Kcs output, unmodulated. Rotate the tuning dial to 150 Kcs on Band 1 and adjust capacitor C35 for zero beat.
B. Set the signal generator to 400 Kcs output, unmodulated. Rotate the tuning dial to 400 Kcs on Band 2 and adjust capacitor C36 for zero beat.
C. Set the signal generator to 2000 Kcs output, unmodulated. Rotate the tuning dial to 2000 Kcs on Band 3 and adjust capacitor C37 for zero beat.
D. Set the signal generator to 5000 Kcs output, unmodulated. Rotate the tuning dial to 5000 Kcs on Band 4 and adjust capacitor C38 for zero beat.

Should the above procedure be unsatisfactory, that is, should it be impossible to obtain zero beat by the adjustments of the padding capacitors on any band or bands, it will be necessary to adjust the inductance by varying the iron core settings; final alignment may then be made by repeating the procedure above.

6-5-3-3. Scale and Tracking Adjustments

With the equipment set-up as described in Sections 6-5-3-1 and 6-5-3-2, check the midband frequencies, 270 Kcs, 700 Kcs, 3500 Kcs, 7500 Kcs, against the dial scale and, if off calibration, readjust as follows:

A. Set the heterodyne oscillator frequency to the correct 1630-Kcs difference frequency from the dial setting by adjusting the iron core inductance of T9, T10, T11 or T12 in bands 1, 2, 3, or 4, respectively.
B. Readjust the top and bottom alignments of the bands as described in Sections 6-5-3-1 and 6-5-3-2.
C. Keep repeating the adjustments as outlined in Sections 6-5-3-1, 6-5-3-2, and 6-5-3-3A until proper alignment is obtained.

When using a crystal in conjunction with the oscillator tuned circuits, no change in the alignment will be necessary.

6-5-4. RF AMPLIFIER AND ANTENNA STAGE ALIGNMENT

6-5-4-1. Trimmer Adjustment

Operate the receiver on M.V.C., crystal switch off, VOLUME control at maximum clockwise position, plug an output meter into J101, and connect a signal generator to the antenna plug through a 100-Mmf dummy antenna. Set the generator for 30% modulation at 400 cycles.

Band 1 Alignment: Set the tuning dial to 400 Kcs on Band 1, and adjust the signal generator to 400 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust trimmer capacitors C6 and C21 for maximum output. Set the signal generator output at 10 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust trimmer capacitors C6 and C21 for maximum output.

Band 2 Alignment: Set the tuning dial to 1100 Kcs on Band 2, reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 1100 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust trimmer capacitors C7 and C22 for maximum output. Set the signal generator output at 10 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust trimmer capacitors C7 and C22 for maximum output.

Band 3 Alignment: Set the tuning dial to 5000 Kcs on Band 3, reset the VOLUME control to maximum clockwise setting and adjust the signal generator to 5000 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust trimmer capacitors C8 and C23 for maximum output, reducing the input from the signal generator as much as necessary to keep the output approximately 50 milliwatts. Set the signal generator output at 10 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust trimmer capacitors C8 and C23 for maximum output.

Band 4 Alignment: Set the tuning dial to 10,000 Kcs on Band 4, reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 10,000 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust trimmer capacitors C9 and C24 for maximum output. Set the signal generator output at 10 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained and readjust trimmer capacitors C9 and C24 for maximum output.

6-5-4-2. Core Adjustment

With the equipment set-up as described in Section 6-5-4-1, core adjustments are made as follows:

Band 1 Alignment: Set the tuning dial to 150 Kcs on Band 1 and adjust the signal generator to 150 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust cores marked 1 on both antenna and RF cans for maximum output. Set the signal generator output at 10 microvolts and reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 1 on the antenna and RF cans for maximum output.

Band 2 Alignment: Set the tuning dial to 400 Kcs on Band 2. Reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 400 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust cores marked 2 on both the antenna and RF cans for maximum output. Set the signal generator output at 10 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 2 on antenna and RF cans for maximum output.

Band 3 Alignment: Set the tuning dial to 2000 Kcs on Band 3. Reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 2000 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust cores marked 3 on both antenna and RF cans for maximum output, reducing the input from the signal generator as much as necessary to keep the output approximately 50 milliwatts. Set the signal generator output at 10 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 3 on both antenna and RF cans for maximum output.

Band 4 Alignment: Set the tuning dial to 5000 Kcs on Band 4. Reset the VOLUME control to maximum clockwise setting, and adjust the signal generator to 5000 Kcs and whatever output is necessary to produce less than 50 milliwatts output. Adjust cores marked 4 on both antenna and RF cans for maximum output. Set the signal generator output at 10 microvolts, reduce the VOLUME control setting to the point at which slightly less than 50 milliwatts output is obtained, and readjust the cores marked 4 on both antenna and RF cans for maximum output.

Repeat successive high- and low-frequency adjustments several times as described in Sections 6-5-4-1 and 6-5-4-2 until successive adjustments show little additional sensitivity.

6-5-5. ADJUSTMENT OF THE IF REJECTION TRAP

Connect the signal generator to the antenna plug through a 100-Mmf capacitor. Set the tuning dial to 1100 Kcs on Band 2, and adjust the signal generator to 25,000 microvolts output at 1630 Kcs, 30% modulation at 400 cycles. Adjust the VOLUME control to the point at which 50 milliwatts output is obtained.

Adjust the iron core of L2 until minimum output is obtained.

7. PARTS BY SYMBOL DESIGNATIONS

7-1. TYPE RA-10C AIRCRAFT RECEIVER

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		MOTOR			
B1	Band Switch Drive & Worm Ass'y	14V DC, 2.5A—no load	Special	24	E11500-2
.	+ Motor Brush	.	Special	25	BA30212-1
.	− Motor Brush	.	Special	25	BA30212-2
		CAPACITORS			
C1	Dummy Loop Padder	140 Mmf ±5%, 500V DCW, Mica	1468	2	C56314-141
C2	Antenna Coupling	10 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-100
C3	Ant. Padder Band 4	100 Mmf ±5%, 500V DCW, Mica	1468	2	C56314-101
C4	Grid Blocking	.001 Mfd ±10%, 500V DCW, Mica	1468	2	C56315-102
C5	IF Trap Coil Padder	.001 Mfd ±2%, 500V DCW, Mica	1468	2	C56313-102
C6	Ant. Trimmer, Band 1	25 Mmf, Variable	APC-25	3	A26829-3
C7	Ant. Trimmer, Band 2	25 Mmf, Variable	APC-25	3	A26829-1
C8	Ant. Trimmer, Band 3	Same as C6	.	.	.
C9	Ant. Trimmer, Band 4	50 Mmf, Variable	APC-50	3	A26829-2
C10	V1 Cathode Bypass	0.1 Mfd ±10%, 400V DCW, Paper	340	4	A18015-104
C11	RF Padder, Band 4	50 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-500
C12A	Antenna Tuning	3 section, Variable	.	1	AC56827-1
C12B	RF Tuning	Same as C12A	.	.	.
C12C	Het. Osc. Tuning	Same as C12A	.	.	.
C13	RF Primary Shunt, Band 2	25 Mmf ±5%, 500V DCW, Mica	1468	2	C56314-250
C14	RF Primary Shunt, Band 1	500 Mmf ±5%, 500V DCW, Mica	1468	2	C56314-501
C15	RF Coupling	5 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-050
C16	Grid Blocking	Same as C4	.	.	.
C17	V1 Screen Bypass	Same as C10	.	.	.
C18	V1 Plate Return Bypass	Same as C10	.	.	.
C19	V2 Screen Bypass	Same as C10	.	.	.
C20	V2 Cathode Bypass	Same as C10	.	.	.
C21	RF Trimmer, Band 1	Same as C6	.	.	.
C22	RF Trimmer, Band 2	Same as C7	.	.	.
C23	RF Trimmer, Band 3	Same as C6	.	.	.
C24	RF Trimmer, Band 4	Same as C9	.	.	.
C25	Osc. Grid Blocking	250 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-251
C26	Osc. Fixed Padder, Band 1	45 Mmf ±2%, 500V DCW, Ceramic	N300L	9	A102055-450
C27	Osc. Fixed Padder, Band 2	85 Mmf ±2%, 500V DCW, Silver Mica	1469	2	C56316-850
C28	Osc. Fixed Padder, Band 3	500 Mmf ±2%, 500V DCW, Silver Mica	1469	2	C56316-501
C29	Osc. Fixed Padder, Band 4	1450 Mmf ±1%, 500V DCW, Silver Mica	1464	2	BA31274
C30	Osc. Trimmer, Band 1	25 Mmf, Variable	APC-25	3	A26829-7
C31	Osc. Trimmer, Band 2	25 Mmf, Variable	APC-25	3	A26829-8
C32	Osc. Trimmer, Band 3	Same as C30	.	.	.
C33	Osc. Trimmer, Band 4	Same as C31	.	.	.
C34	Osc. Fixed Trimmer, Band 1	35 Mmf ±10%, 500V DCW, Ceramic	N680K	9	A18207-350
C35	Osc. Padder, Band 1	Same as C30	.	.	.
C36	Osc. Padder, Band 2	Same as C30	.	.	.
C37	Osc. Padder, Band 3	50 Mmf, Variable	APC-50	3	A26829-6
C38	Osc. Padder, Band 4	Same as C37	.	.	.
C39	Osc. Fixed Trimmer, Band 2	10 Mmf ±10%, 500V DCW, Ceramic	N680L	9	A18205-100
C40	Osc. Fixed Trimmer, Band 3	20 Mmf ±10%, 500V DCW, Ceramic	N680K	9	A18207-200
C41	Osc. Fixed Trimmer, Band 4	30 Mmf ±2%, 500V DCW, Ceramic	N300L	9	A102055-300
C42	V7 Cathode Bypass	Same as C74	.	.	.
C43	Osc. Plate Return Bypass	.01 Mfd ±2%, 500V DCW, Mica	1467	2	C56310-103
C44	Osc. Plate Return Bypass	Same as C43	.	.	.
C45	1st IF Pri. Trimmer	115 Mmf ±2%, 500V DCW, Silver Mica	1469	2	C56316-1150
C46	1st IF Sec. Trimmer	Same as C45	.	.	.
C47	2nd IF Pri. Trimmer	Same as C45	.	.	.

7-1. TYPE RA-10C AIRCRAFT RECEIVER—Continued

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		CAPACITORS (Continued)			
C48	2nd IF Sec. Trimmer	Same as C45	.	.	.
C49	CW Osc. Coupling	1.0 Mmf ±20%, 500V DCW, Ceramic	P120K10	9	BA30763
C50	V2 Plate Bypass	Same as C10	.	.	.
C51	V3 Grid Bypass	.02 Mfd ±10%, 400V DCW, Paper	342-12	4	A18015-203
C52	V3 Cathode Bypass	Same as C10	.	.	.
C53	V3 Screen Bypass	Same as C10	.	.	.
C54	V3 Plate Bypass	Same as C10	.	.	.
C55	V4 Cathode Bypass	Same as C10	.	.	.
C56	V4 Screen Bypass	Same as C10	.	.	.
C57	V4 Plate Return Bypass	Same as C10	.	.	.
C58	AVC Bus Bypass	Same as C10	.	.	.
C59	3rd IF Pri. Trimmer	Same as C45	.	.	.
C60	3rd IF Sec. Trimmer	Same as C45	.	.	.
C61	V5 Diode Return Filter	150 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-151
C62	V5 Grid Blocking	.01 Mfd ±10%, 300V DCW, Mica	1467	2	C56312-103
C63	V5 Diode Return Filter	50 Mmf ±20%, 300V DCW, Mica	Q	4	A113365-500
C64	AVC Diode Coupling	Same as C11	.	.	.
C65	V5 Cathode Bypass	1.0 Mfd 100V DCW, Paper	.	20	A204-5
C66	V2 Grid Bypass	75 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-750
C67	V2 Grid Bypass	35 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-350
C68	CW Osc. Grid	Same as C61	.	.	.
C69	CW Osc. Trimmer	450 Mmf ±2%, 500V DCW, Mica	1469	2	C56316-451
C70	CW Osc. Plate Bypass	Same as C10	.	.	.
C71	CW Osc. Bypass	Same as C10	.	.	.
C72	V5 to V7 Grid Blocking	.01 Mfd ±5%, 300V DCW, Mica	1467	2	C56311-103
C73	1st Audio Plate Bypass	Same as C14	.	.	.
C74	V8 Cathode Bypass	16 Mfd 50V, Electrolytic	BR	20	BA30986
C75	V8 Plate Filter	.002 Mfd ±5%, 500V DCW, Mica	1467	2	C56311-202
C76	V7 Plate Filter	Same as C75	.	.	.
C77A	High Voltage Supply Filter	30-30-30 Mfd 350V DCW, Electrolytic	FP-3X	8	A30189
C77B	High Voltage Supply Filter	Same as C77A	.	.	.
C77C	High Voltage Supply Filter	Same as C77A	.	.	.
C78A	Low Voltage Supply Filter	.1-.1-.1 Mfd ±10%, 400V DCW, Paper	.	2	E11347-1
C78B	HV Supply Filter	Same as C78A	.	.	.
C78C	HV Supply Filter	Same as C78A	.	.	.
C79A	Low Voltage Input Filter	.5-.5 Mfd ±10%, 100V DCW, Paper	.	2	E11400
C79B	Low Voltage Input Filter	Same as C79A	.	.	.
C80	RF Padder, Band 4	20 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-200
C81	B. F. O. Coupling Cond.	Same as C15	.	.	.
C82	Osc. Fixed Trimmer, Band 4	Same as C41	.	.	.
C83	CW Osc. Trimmer	50 Mmf ±5%, 500V DCW, Ceramic	N680K	9	A18206-500
C84	1st IF Pri. Trimmer	Same as C39	.	.	.
C85	1st IF Sec. Trimmer	Same as C39	.	.	.
C86	2nd I.F. Pri. Trimmer	Same as C39	.	.	.
C87	2nd I.F. Sec. Trimmer	Same as C39	.	.	.
C88	3rd I.F. Pri. Trimmer	Same as C39	.	.	.
C89	3rd I.F. Sec. Trimmer	Same as C39	.	.	.
C90	Osc. Fixed Padder, Band 2	Same as C41	.	.	.
		DYNAMOTOR AND BRUSHES			
D1	Dynamotor	14V, 3.3A, input; 230V, 0.1A, output	BM15	1	C56728-1
.	Low Voltage + Brush	.	BM15	1	BA30188-1
.	Low Voltage − Brush	.	BM15	1	BA30188-2
.	High Voltage + Brush	.	BM15	1	BA30188-3
.	High Voltage − Brush	.	BM15	1	BA30188-4

7-1. TYPE RA-10C AIRCRAFT RECEIVER—Continued

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		JACKS			
J1	Wall Mounting Recep. for Plug P1	23 contact	NK-C23-325	11	BA30094
J6	Crystal Socket	3 prong, for MX-9E		22	A15202
		RELAYS			
K1	Crystal On-Off	14 Volt	Special	1	AA112579-1
K2	Side-Tone	150-ohm coil, SPDT	Special	12	AA110936
K3	Silencing	320-ohm coil, SPDT	P-3	12	A114293
		INDUCTORS			
L1	Dummy Loop	Assembly	.	1	AC55706-1
L2	IF Trap	Same as L1	.	.	.
L3	BFO Coil	Assembly	.	1	AC62030-1
L4	Filter Choke	Part of T16 assembly	.	1	.
L5	HV Hash Filter	1200T No. 33 SSE, 40 ohms	.	1	AA115726-2
L6	LV Hash Filter	.	.	1	AA115726-1
L7	LV Hash Filter	Same as L6	.	.	.
		PLUG			
P1	Junction Box to Receiver Cable	23-contact, 90°, Female	NK-C23-23-⅝B	11	BA30601
		RESISTORS			
R1	V1 Cathode Initial Bias	300 ohms, ±10%, ¼W	.	9	A32298-301
R2	V1 Control Grid Decoupling	5 Megohm, ±10%, ¼W	.	9	A32298-505
R3	V1 Screen Dropping	100,000 ohms, ±10%, ¼W	.	9	A32298-104
R4	V9 Bias	250 ohms, ±10%, ¼W	.	9	A32298-251
R5	V9 Bleeder	50,000 ohms, ±10%, ½W	.	9	A112933-503
R6	V1 Plate Decoupling	1,000 ohms, ±10%, ¼W	.	9	A32298-102
R7	V2 Screen Dropping	15,000 ohms, ±10%, 1W	.	9	A112925-153
R8	V2 Control Grid Decoupling	Same as R2	.	.	.
R9	V2 Cathode Initial Bias	Same as R4	.	.	.
R10	V2 Control Grid Leak	50,000 ohms, ±10%, ¼W	.	9	A32298-503
R11	V2 Plate Decoupling	Same as R6	.	.	.
R12	V3 Control Grid Decoupling	Same as R10	.	.	.
R13	V3 Cathode Initial Bias	Same as R1	.	.	.
R14	V3 Screen Dropping	Same as R3	.	.	.
R15	V3 Plate Decoupling	Same as R6	.	.	.
R16	V2 Osc. Plate Decoupling	35,000 ohms, ±10%, ¼W	.	9	A32298-353
R17	V4 Cathode Initial Bias	Same as R1	.	.	.
R18	V4 Screen Dropping	Same as R3	.	.	.
R19	V4 Plate Decoupling	Same as R6	.	.	.
R20	V5 Diode Return Filter	500,000 ohms, ±5%, ¼W	.	9	A32014-504
R21	V5 Control Grid Leak	Same as R20	.	.	.
R22	V5 Diode Return Filter	Same as R20	.	.	.
R23	V5 AVC Delay	5,000 ohms, ±10%, ¼W	.	9	A32298-502
R24	V5 AVC Diode Load	1 Megohm, ±10%, ¼W	.	9	A32298-105
R25	V5 AVC Buss Filter	Same as R24	.	.	.
R26	V5 Plate Load	Same as R10	.	9	.
R27	V7 Grid Return	500,000 ohms, ±10%, ¼W	.	9	A32298-504
R28	CW Osc. Grid Leak	Same as R10	.	.	.
R29	V6 Plate Voltage Bleeder	Same as R27	.	.	.
R30	V6 Plate Voltage Bleeder	75,000 ohms, ±10%, ¼W	.	9	A32298-753
R31	V8 Cathode Bias	500 ohms, ±10%, ½W	.	9	A112931-501
R32	K2 Dropping	150 ohms, ±5%, 5W	5W	10	A18133-151
R33	B+ to Cathode, Bleeder	20,000 ohms, ±10%, 1W	.	9	A112925-203
R34	B+ to Cathode, Bleeder	Same as R33	.	.	.

7-1. TYPE RA-10C AIRCRAFT RECEIVER—Continued

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		RESISTORS (Continued)			
R35	Voltage Dropping	Section D; 120 ohms, 1.50W	MW-5	10	A27941
R36	Voltage Dropping	Section F; 61 ohms, 2W	MW-5	10	A27941
R37	Voltage Dropping	Section E; 71 ohms, 2.68W	MW-5	10	A27941
R39	Voltage Dropping	Section B; 25 ohms, 2.25W	MW-5	10	A27941
R40	Voltage Dropping	Section A; 50 ohms, 4.5W	MW-5	10	A27941
		Section C; link	MW-5	10	A27941
R38	Filament Equalizing	125 ohms, ±5%, 5W	5W	10	A18133-1250
R41	V5 Cathode Bias	3,000 ohms, ±10%, ¼W	.	9	A32298-302
R42	V7 Cathode Bias	Same as R31	.	.	.
		SWITCHES			
S1	Ant. Pri. Band Selector	Bakelite wafer, 4-position	H	16	A100000
S2	Ant. Sec. Band Selector	Bakelite wafer, 4-position	H	16	A28002
S3	RF Pri. Band Selector	Bakelite wafer, 4-position	H	16	A28003
S4	RF Sec. Band Selector	Same as S2	.	.	.
S5	Osc. Pri. Band Selector	Ceramic wafer, 4-position	H	16	A102006
S6	Osc. Sec. Band Selector	Ceramic wafer, 4-position	H	16	A102007
S7	Motor Positioning	Bakelite wafer	H	16	A16301
S8	Motor Control	1 make, 2 break, Non-locking	.	18	C57496
S9	Crystal Control	.	H	16	A15280
		TRANSFORMERS			
T1	Antenna, Band 1	Complete assembly	.	1	AA29982-1
T2	Antenna, Band 2	Complete assembly	.	1	AA29978-1
T3	Antenna, Band 3	Complete assembly	.	1	AL71765-9
T4	Antenna, Band 4	Complete assembly	.	1	AL71765-10
T5	RF Band 1	Complete assembly	.	1	AL71765-5
T6	RF Band 2	Complete assembly	.	1	AL71765-6
T7	RF Band 3	Complete assembly	.	1	AL71765-7
T8	RF Band 4	Complete assembly	.	1	AL71765-8
T9	Osc., Band 1	Complete assembly	.	1	AL71765-1
T10	Osc., Band 2	Complete assembly	.	1	AL71765-2
T11	Osc., Band 3	Complete assembly	.	1	AL71765-3
T12	Osc., Band 4	Complete assembly	.	1	AL71765-4
T13	1st IF Assembly	Complete assembly	.	1	AC61967-1
T14	2nd IF Assembly	Complete assembly	.	1	AC61966-1
T15	3rd IF Assembly	Complete assembly	.	1	AC61967-1
T16	Audio Output	Includes L4, 1st Channel Output	.	1	AA16901
T17	Audio Output	2nd channel output	.	1	AA14814
		TUBES			
V1	RF Amplifier	Triple-grid, super-control	6SK7	21	.
V2	Combination Het. Osc.-Mixer	Triode-hexode converter	6K8	21	.
V3	1st IF Amplifier	Same as V1	.	.	.
V4	2nd IF Amplifier	Same as V1	.	.	.
V5	2nd Det.-AVC-1st Audio	Duplex-diode triode	6R7	21	.
V6	CW BFO	Detector-amplifier triode	6C5	21	.
V7	2nd Audio, 1st Channel	Power amplifier pentode	6K6-G	21	.
V8	2nd Audio, 2nd Channel	Same as V7	.	.	.
		CRYSTALS			
X3	Lock-in Crystal and Holder	Complete assembly (See Section 2-1-2-11)	MX-9E	1	AL71157-1
X4	Lock-in Crystal and Holder	Same as X3	.	.	.

7-2. TYPE RA-10D AIRCRAFT RECEIVER

The RA-10D Receiver uses the same parts as an RA-10C except for the following:

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		MOTOR			
B1	Band Switch Drive	28V DC, 1.25A—no load	Special	24	E11500-1
		DYNAMOTOR			
D1	Dynamotor	28V 1.6A, input; 230V, 0.1A output	BM15	1	C56728-2
		RELAY			
K1	Crystal On-off	28-Volt	Special	1	C56864-2

7-3. TYPE RA-10CD AIRCRAFT RECEIVER

The RA-10CD Receiver uses the same parts as an RA-10C except for the following:

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		CAPACITOR			
C67A	Crystal Shunt	75 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-750

7-4. RA-10DD AIRCRAFT RECEIVER

The RA-10DD Receiver uses the same parts as the RA-10D except for the following:

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
C67A	Crystal Shunt	75 Mmf ±10%, 500V DCW, Mica	1468	2	C56315-750

7-5. TYPE MR-9BB REMOTE CONTROL UNIT

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		FUSE			
F101	Protective	25V 10A., 3AG	1081-C	7	A11302-28
		LAMP			
I101	Instrument	3V, 0.19 ± .020A	.	13	A18881-1
		RECEPTACLES			
J2	Wall Mounting for P2	16-contact	SK-C16-32S 11	11	BA30089
J101	Phone Jack	Open circuit	XG-315	17	A28960
J102	Phone Jack	Same as J101	.	.	.
.	Fuse Holder	.	1075A	7	A30003
		PLUG			
P2	Remote to Junction Box Cable	16-contact, Straight, Female	SK-C16-21-½B	11	BA30090

7-5. TYPE MR-9BB CONTROL UNIT—Continued

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		RESISTORS			
R101A	Dual Volume Control	1500 ohms, ±20%	.	23	A15247
R101B	Dual Volume Control	25,000 ohms, ±20%	.	23	A15247
R102	Audio Load	500 ohms, ±10%, ½W	.	9	A18150-501
R103	Inst. Lamp Voltage Dropping	61 ohms-71 ohms, Total 132 ohms (RA-10C 71 ohms section shunted)	.	10	A31356
R104A	Minimum Output Loading	250 ohms, ±10%, ½W	.	9	A18150-251
		SOCKET			
.	Lamp Socket	For Lamp I101	.	1	AA15246
		SWITCHES			
S101A	Band Selector	2 pole, 4 position	H	16	A15248
S101B	Band Selector	2 pole, 4 position	H	16	A15247
S102	AVC, MVC and CW Selector	4 pole, 3 position	3143J	8	A15405
S102A	Off, Loop and XTAL Selector	Same as S102	.	.	.
S104	Power On-Off	Part of R101	.	.	.

7-6. TYPE MR-9CB REMOTE CONTROL UNIT

The MR-9CB Remote Control Unit uses the same parts as an MR-9BB except for the following: (See Section 2-2)

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		RESISTORS			
R101A	Dual Volume Control	10,000 ohms, ±20%	JJS	23	L72688
R101B	Dual Volume Control	25,000 ohms, ±20%	JJS	23	L72688
R102	Audio Load	4000 ohms, ±10%, ½W	.	9	A18150-402
R104	Minimum Output Loading	2000 ohms, ±10%, ½W	.	9	A18150-202

7-7. TYPE MN-52JA AZIMUTH CONTROL UNIT

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		LAMPS			
I301	Instrument	3V, 0.19A ± 0.02A	.	13	A18881-1
		RECEPTACLE			
J4	Recep. for P4	6-contact, Wall mounting	WK-6-32S	11	BA30084
		PLUG			
P4	Azimuth Control to Junction Box Cable	6-contact, Straight, Female	WK-6-21-⅜B	11	BA30088
		SOCKET			
.	Lamp Socket	For Lamp I301	.	1	A14417
		SWITCHES			
S301	Loop-Antenna Selector	SPST, Toggle	.	14	A110327
S303	Instrument Lamp	Same as S301	.	.	.

7-8. TYPE MR-11C LOOP RELAY UNIT

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		CAPACITOR			
C201	Dummy Antenna Resonator	100 Mmf, ±5%, 500V DCW, Mica	1468	2	C56314-101
		RECEPTACLE			
J3	Receptacle for P3	6-contact, Wall mounting	WK-6-32S	.	A30084
		PLUG			
P3	Loop Cable to Relay Unit	6-contact, Straight, Female	WK-6-21-⅜B	11	A30088
		RELAY			
K201	Loop-Antenna Control	14-volt	.	1	AC60096-1
		SWITCH			
S201	Loop-Antenna Selector	4-pole, 2-position, Shorting	.	1	A15462

7-9. TYPE MR-11D LOOP RELAY UNIT

The MR-11D uses the same parts as the MR-11C except for the following:

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		RELAY			
K201	Loop-Antenna Control	28-volt	.	1	C60096-2

7-10. TYPE MN-20E AND TYPE MN-24C ROTATABLE LOOP

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		RECEPTACLE			
J5	Receptacle for P5	6-contact, Wall Mounting	.	1	A120609
		INDUCTANCE			
L8	Loop Inductance	Complete 9″ Loop Assembly for Type 20E	.	.	AL74823-1
L8	Loop Inductance	Complete 18″ Loop Assembly for Type 24C	.	.	.AL74847-1

7-11. TYPE MN-46B FIXED LOOP

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		RECEPTACLE			
J5	Receptacle for P5	6-contact, Wall Mounting	.	1	A120609
		INDUCTANCE			
.	Shunt Inductance	Adjustable iron core coil	.	1	AL71687-18

7-12. TYPE MN-40D AZIMUTH INDICATOR

Symbol Number	*Function*	*Description of Part*	*Mfr's. Desig.*	*Mfr.*	*Bendix Number*
		RESISTORS			
.	14-volt pilot light dropping resistor	116 ohm wire wound, ±5%	.	10	A100199-1
.	28-volt pilot light dropping resistor	264 ohm wire wound, ±5%	.	10	A100199-2
		LAMP			
.	Dial Light	3V, 0.19A, ±0.02A	.	.	A18881-1

8. LIST OF MANUFACTURERS

1. Bendix Radio Division,
   Bendix Aviation Corporation,
   Baltimore 4, Maryland
2. Aerovox Corporation,
   New Bedford, Mass.
3. Hammarlund Mfg. Co., Inc.,
   424 W. 33rd Street,
   New York, N. Y.
4. Micamold Radio Corporation,
   1097 Flushing Avenue,
   Brooklyn, N. Y.
5. General Electric Company,
   1 River Road,
   Schenectady, N. Y.
6. Centralab,
   900 E. Keefe Avenue,
   Milwaukee, Wisconsin
7. Littlefuse, Inc.,
   4757 Ravenswood Ave.,
   Chicago, Illinois
8. P. R. Mallory and Co., Inc.,
   Yaxley Division,
   3029 E. Washington Street,
   Indianapolis, Ind.
9. Erie Resistor Co.,
   644 W. 12th Street,
   Erie, Penna.
10. International Resistor Corp.,
    401 N. Broad Street,
    Philadelphia, Penna.
11. Cannon Electrical Development Co.,
    420 West Avenue 33,
    Los Angeles, California
12. Leach Relay Company,
    1915 Avalon Boulevard,
    Los Angeles, California
13. Pioneer Instrument Co., Inc.,
    Bendix, N. J.
14. Hart and Hegeman Division,
    Arrow-Hart and Hegeman Electric Co.,
    3201 Arch Street
    Philadelphia, Penna.
15. Eicor, Inc.,
    515 South Lafling Street,
    Chicago, Illinois
16. Oak Manufacturing Co.,
    1260 Clybourn Avenue,
    Chicago, Illinois
17. Carter Division, Utah Radio Products,
    812 Orleans Street,
    Chicago, Illinois
18. Kellogg Switchboard & Supply Co.,
    6650 South Cicero Ave.,
    Chicago, Illinois
19. Ohmite Mfg. Co.,
    4835 Flournoy Street,
    Chicago, Illinois
20. Cornell-Dubilier Elec. Corp.,
    1006 Hamilton Blvd.,
    South Plainfield, N. J.
21. RCA Radiotron Div., RCA Mfg. Co., Inc.,
    401 Bergen Street,
    Harrison, N. J.
22. Cinch Mfg. Corp.,
    2335 W. Van Buren Street,
    Chicago, Illinois
23. Allen-Bradley Co.,
    Milwaukee, Wisconsin
24. A. G. Redmond Co.,
    Owosso, Michigan
25. Morganite Brush Co., Inc.,
    Long Island City,
    New York, N. Y.

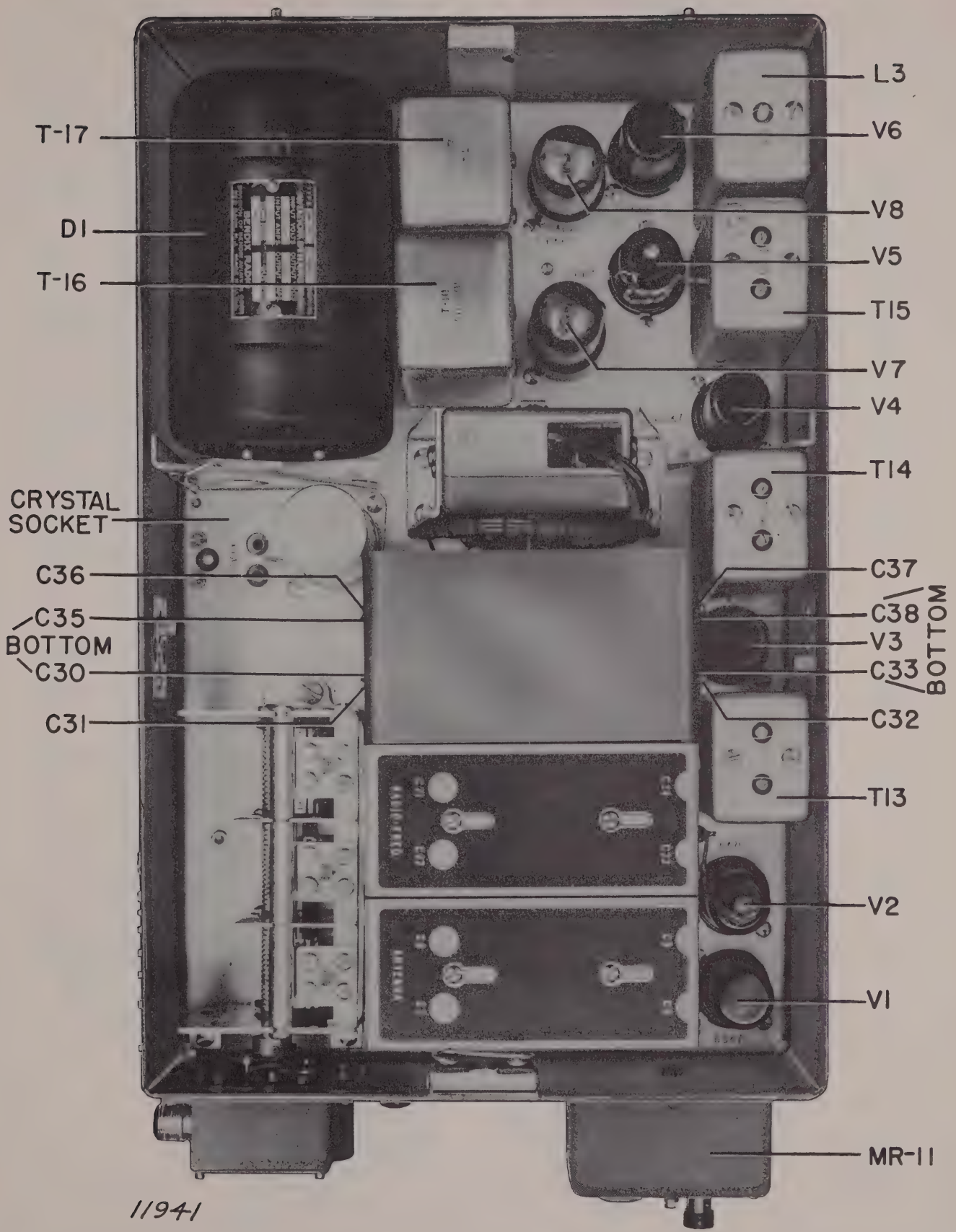


Fig. 2—Top View, Receiver Chassis

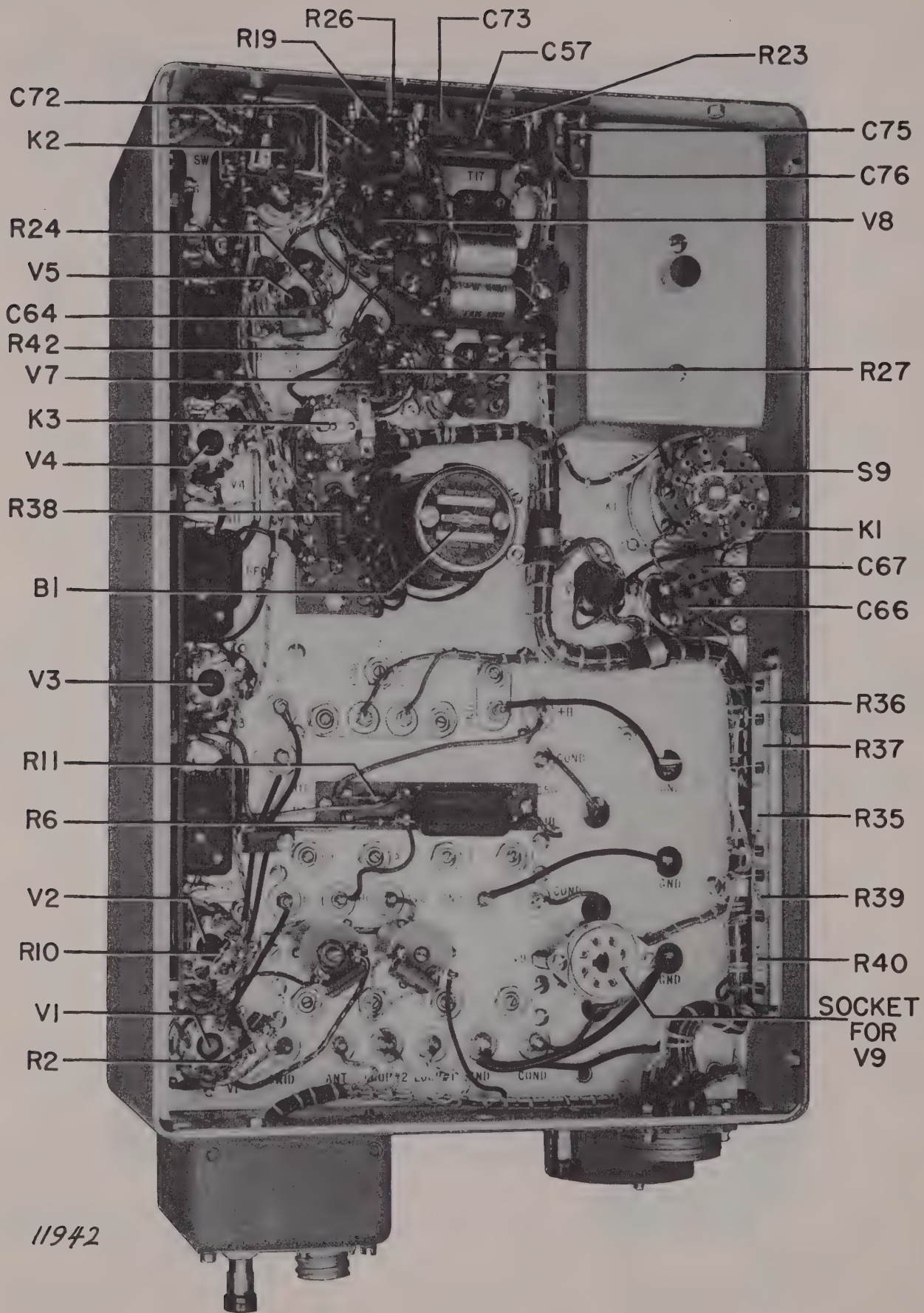


Fig. 3—Right Bottom Oblique View, Receiver Chassis

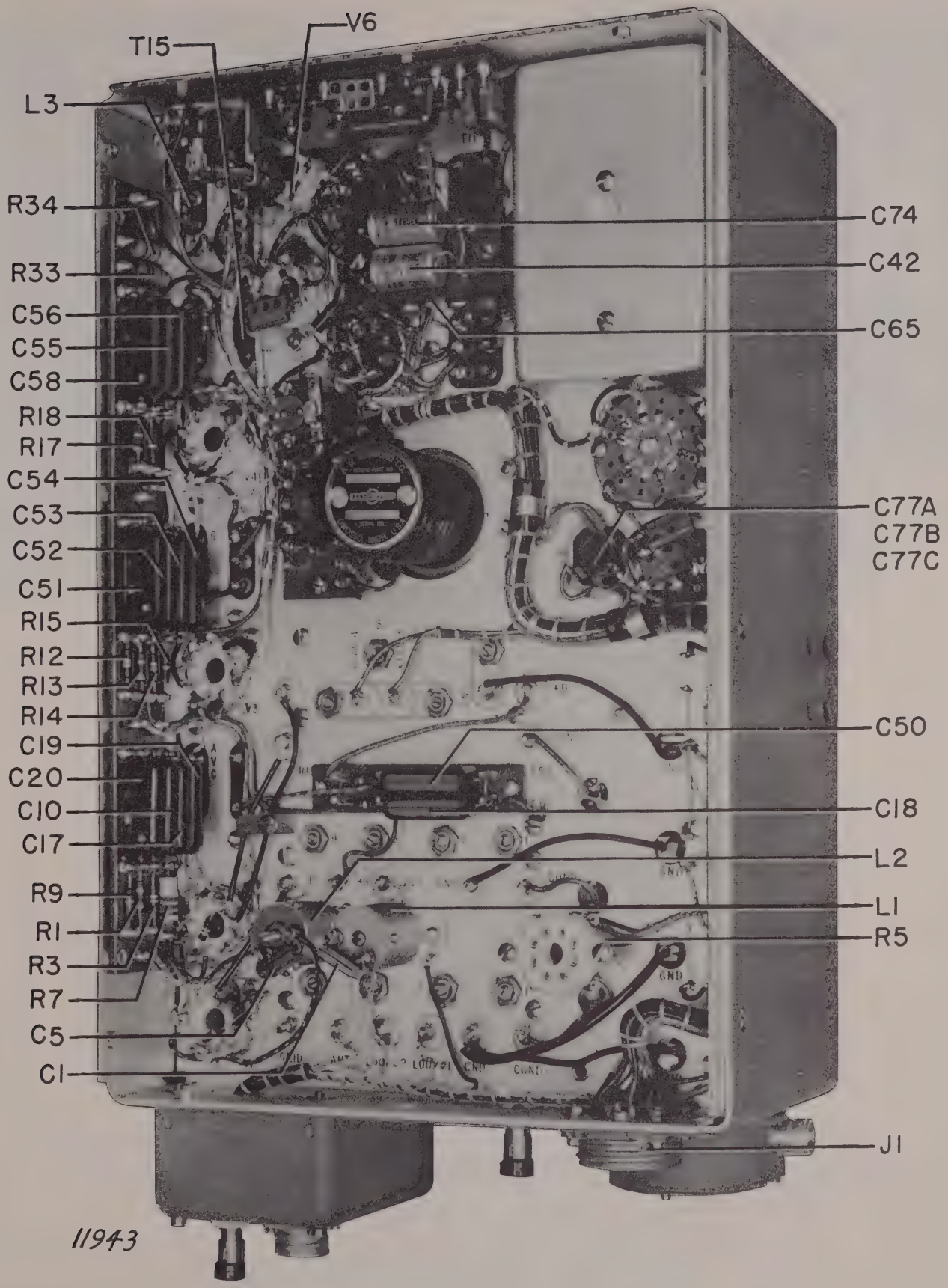
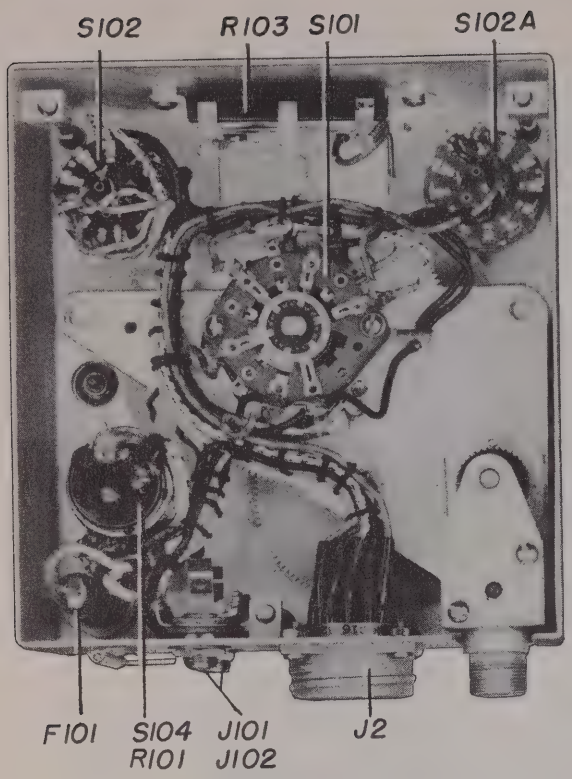
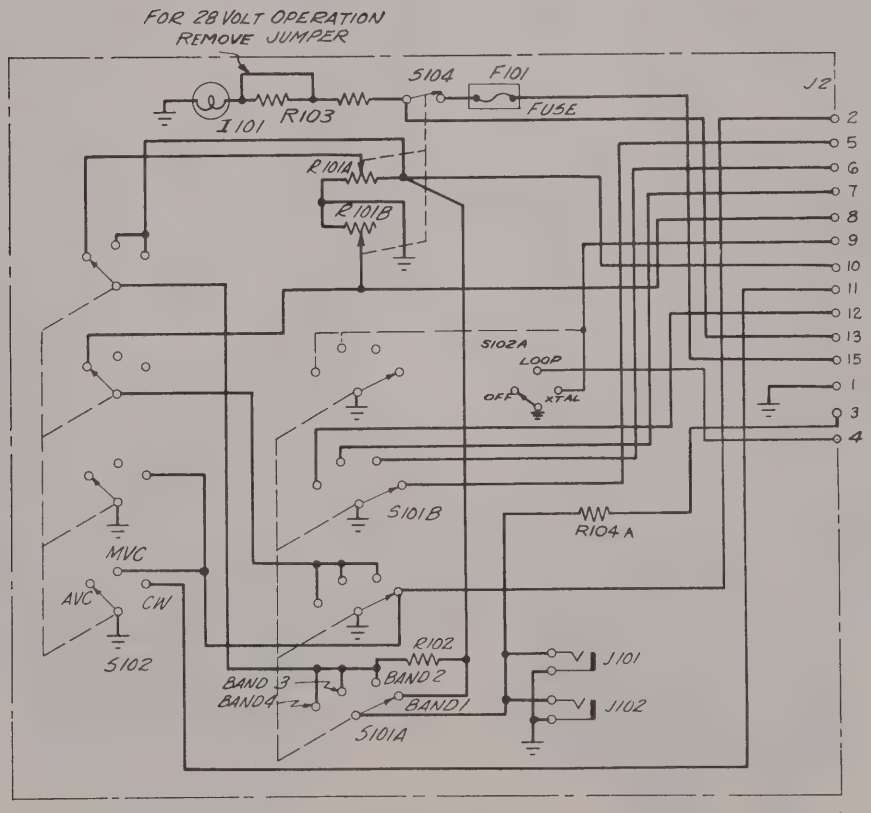


Fig. 4—Left Bottom Oblique View, Receiver Chassis

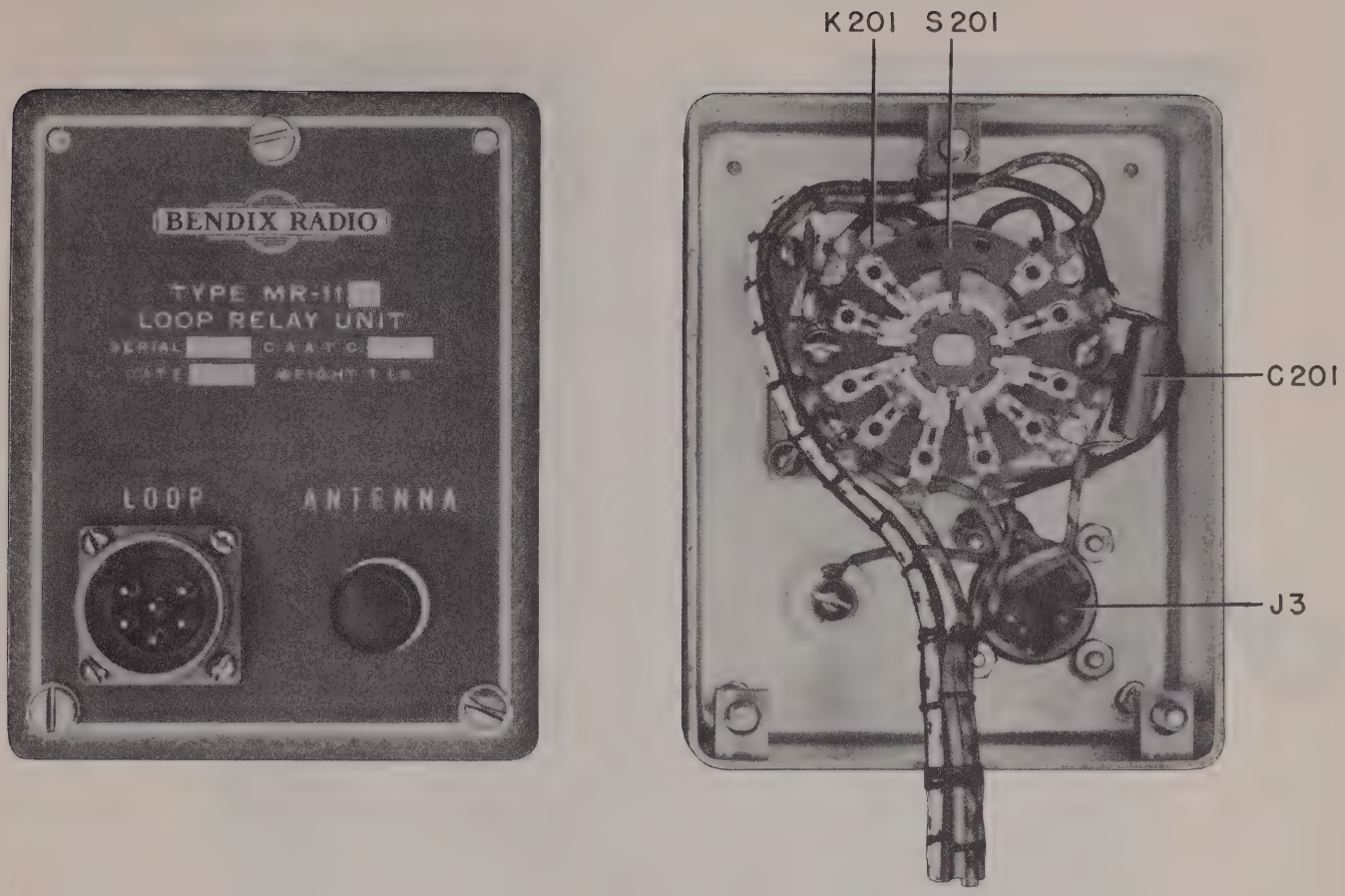




MR-9BB OR MR-9CB REMOTE CONTROL UNIT.-DOTTED CONNECTION BETWEEN S-101B AND S-102A IS USED WHEN EQUIPMENT IS ORDERED FOR CRYSTAL CONTROLLED FIXED FREQUENCIES ONLY ON BANDS 3 AND 4.

R212313

Fig. 5—Type MR-9BB or MR-9CB Remote Control Unit



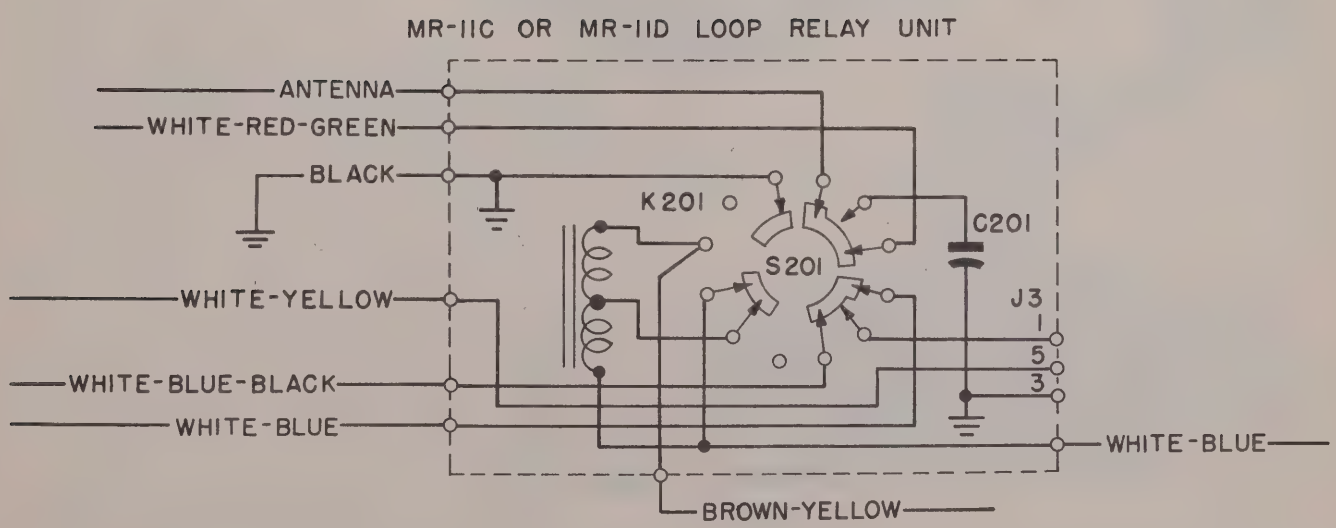
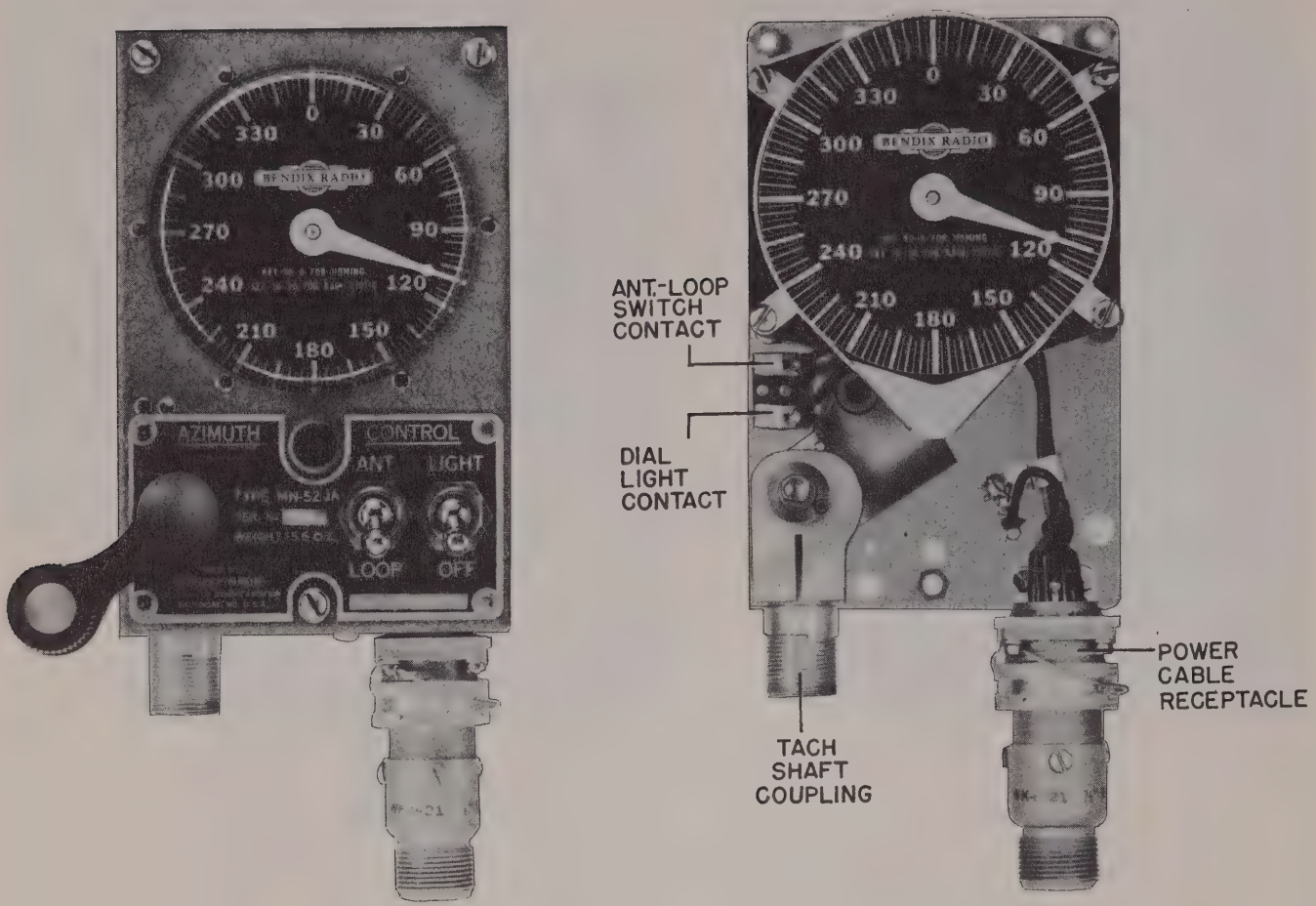
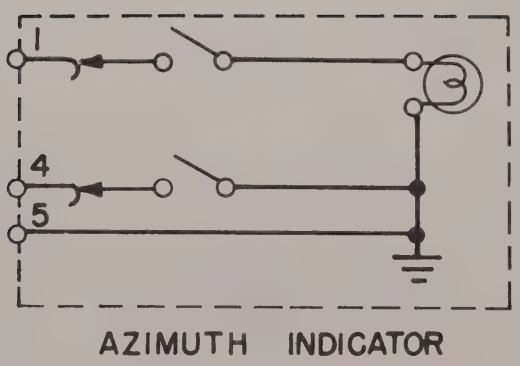


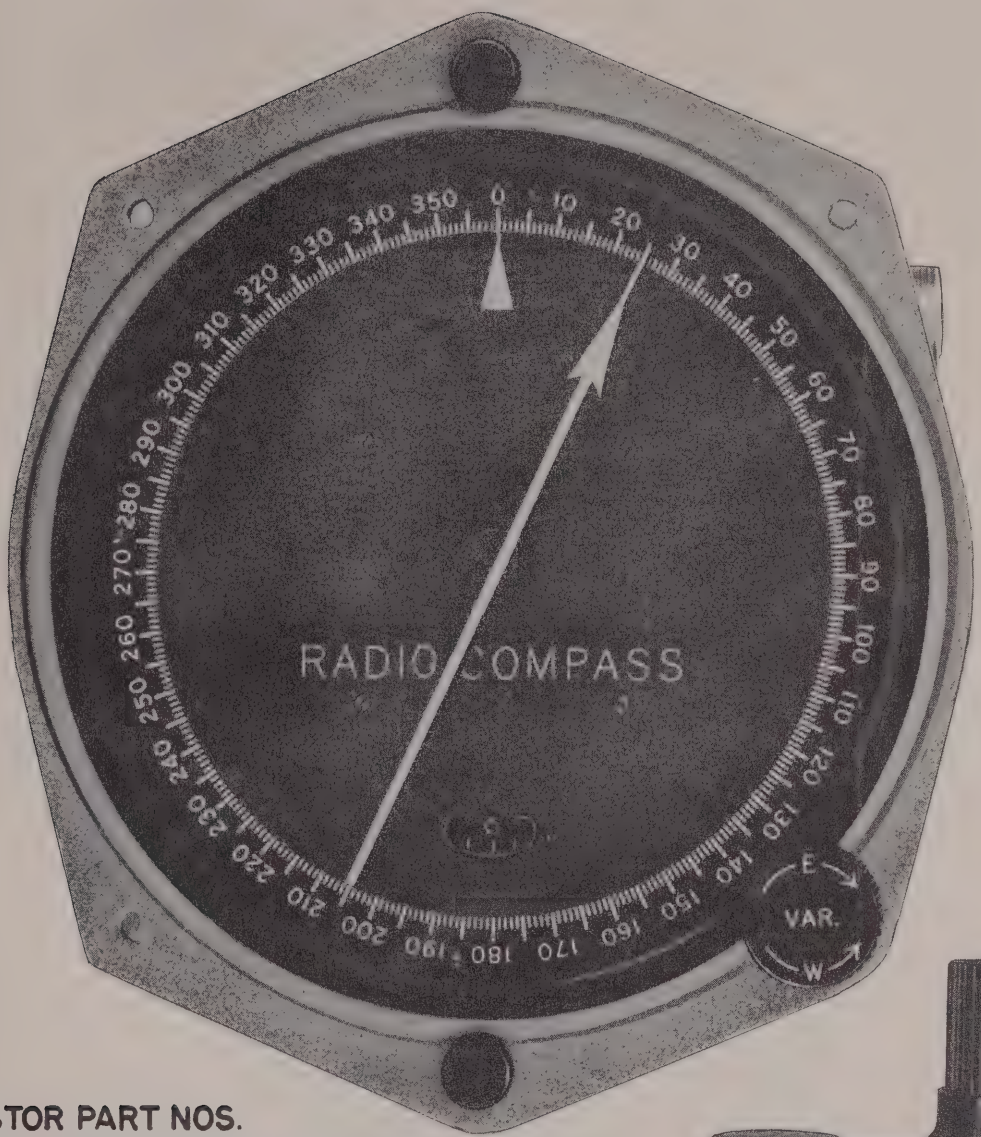
Fig. 6—Type MR-11C or MR-11D Loop Relay Unit



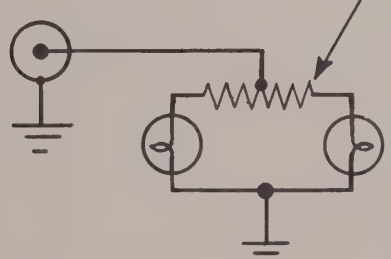


AZIMUTH INDICATOR

Fig. 7—Type MN-52JA Azimuth Control



RESISTOR PART NOS.
FOR 14 VOLT OPERATION-A100199-1
FOR 28 VOLT OPERATION-A100199-2



7708

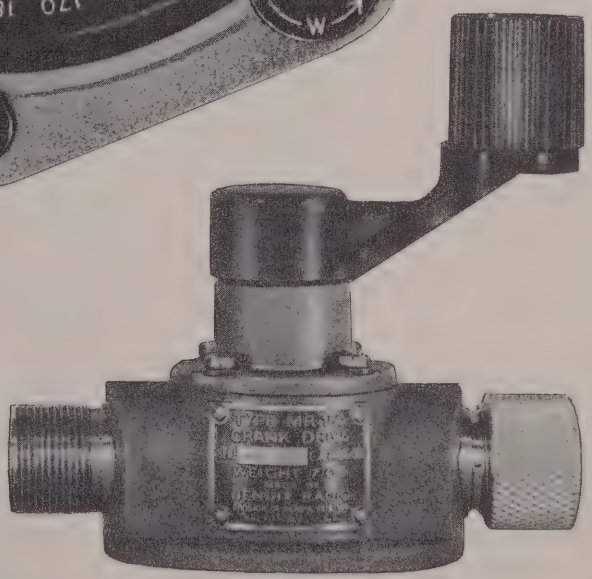


Fig. 8—Type MN-40D Azimuth Indicator and Type MR-15A Crank Drive

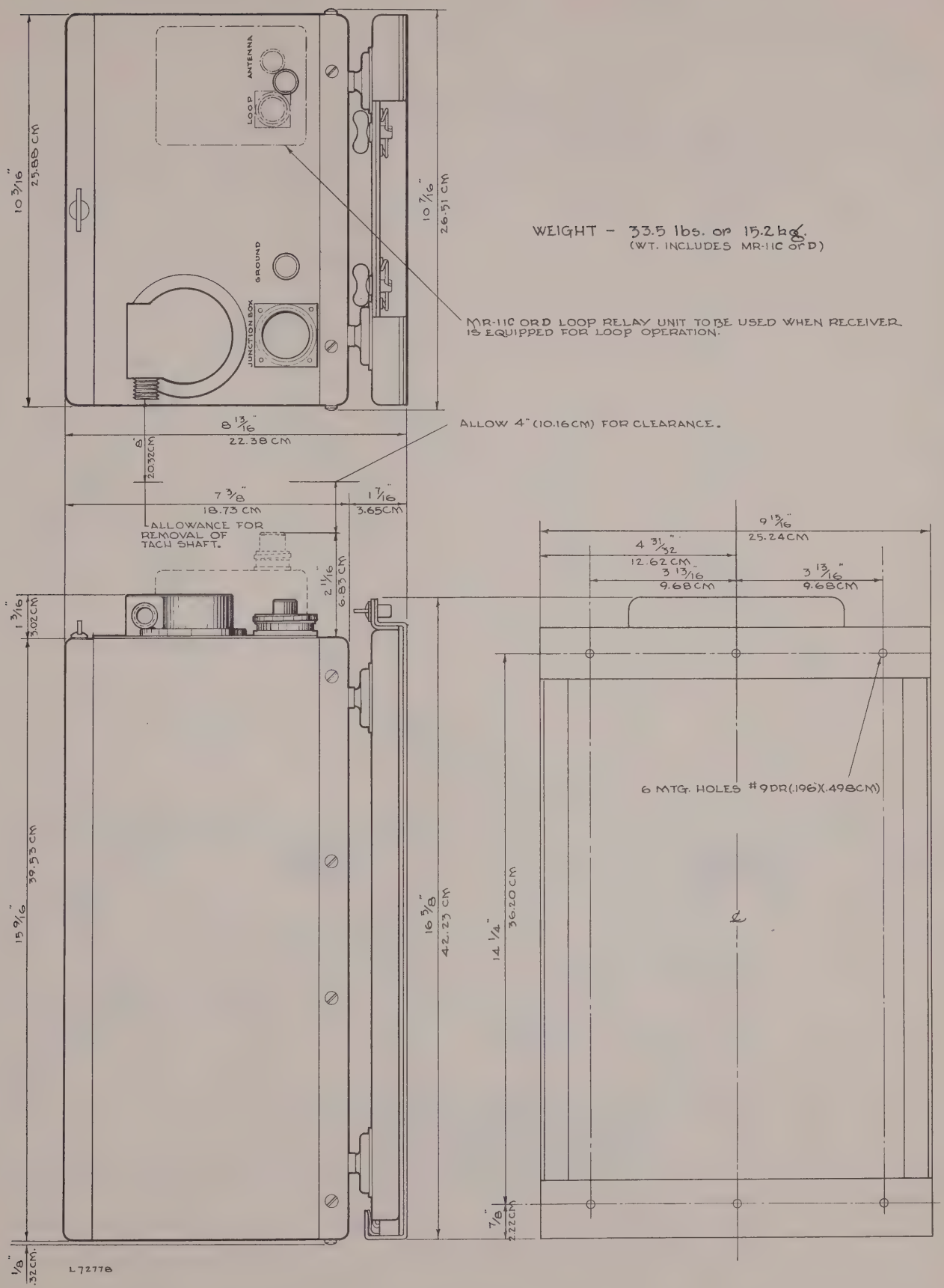
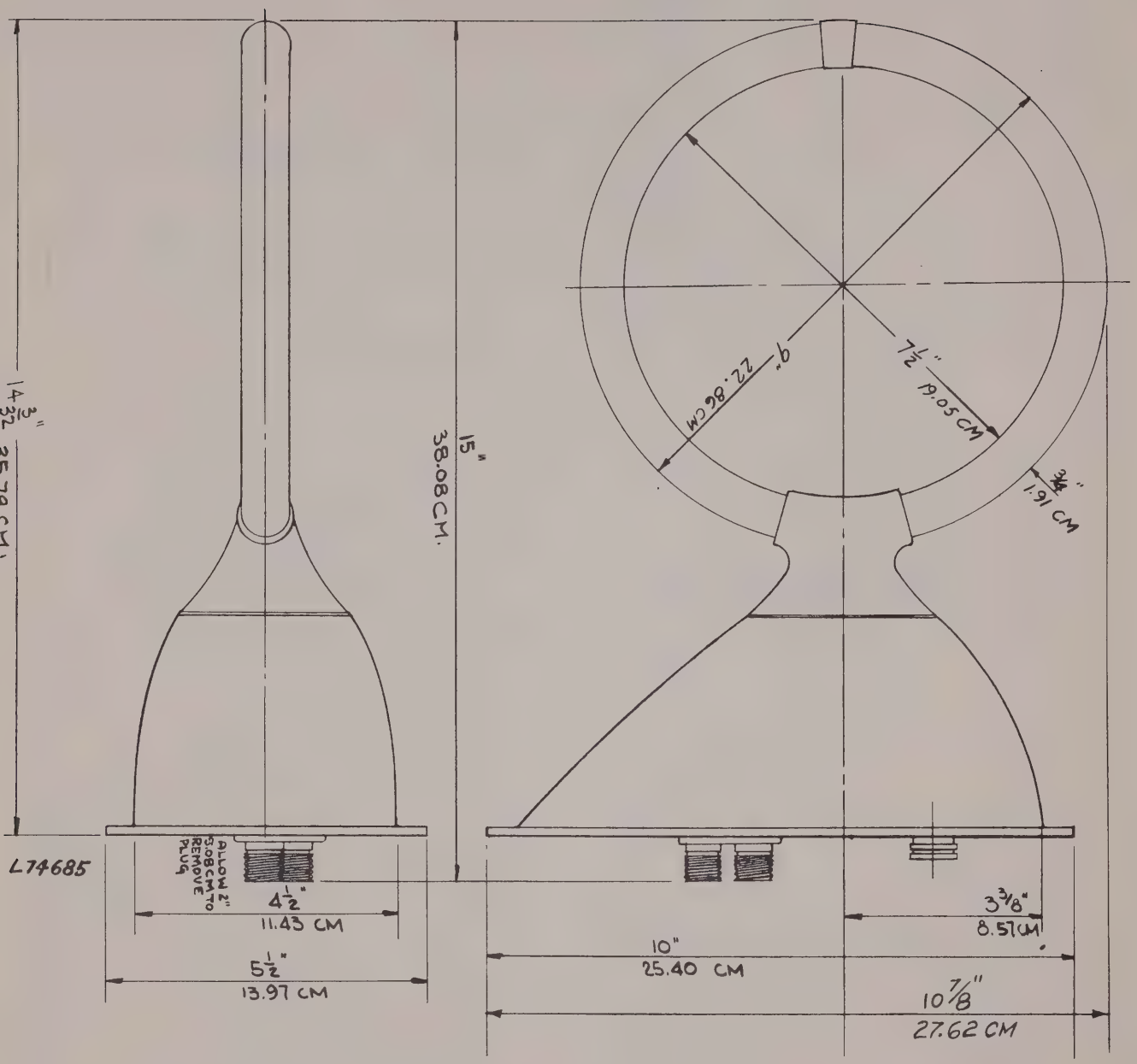

LOOP ANTENNA
GROUND
JUNCTION BOX
10 3/16" 25.88 CM
10 7/16" 26.51 CM
WEIGHT - 33.5 lbs. or 15.2 kg.
(WT. INCLUDES MR-11C or D)
MR-11C OR D LOOP RELAY UNIT TO BE USED WHEN RECEIVER IS EQUIPPED FOR LOOP OPERATION.
ALLOW 4" (10.16 CM) FOR CLEARANCE.
8 13/16" 22.38 CM
8" 20.32 CM
7 3/8" 18.73 CM
1 7/16" 3.65 CM
ALLOWANCE FOR REMOVAL OF TACH SHAFT.
2 1/16" 6.83 CM
1 3/16" 3.02 CM
15 9/16" 39.53 CM
16 5/8" 42.23 CM
14 1/4" 36.20 CM
7/8" 2.22 CM
1/8" .32 CM.
9 15/16" 25.24 CM
4 31/32" 12.62 CM
3 13/16" 9.68 CM
3 13/16" 9.68 CM
6 MTG. HOLES #9 DR (.196) (.498 CM)
L72778

Fig. 9—Outline and Mounting Dimensions, Type RA-10 Receiver



TRUE INDUCTANCE 18.5 MICROHENRIES
DISTRIBUTED CAPACITY 68
MICROMICROFARADS.
Q = 75 AT 1000 KCS.

Fig. 10—Outline Dimensions, Type MN-20E Rotatable Loop

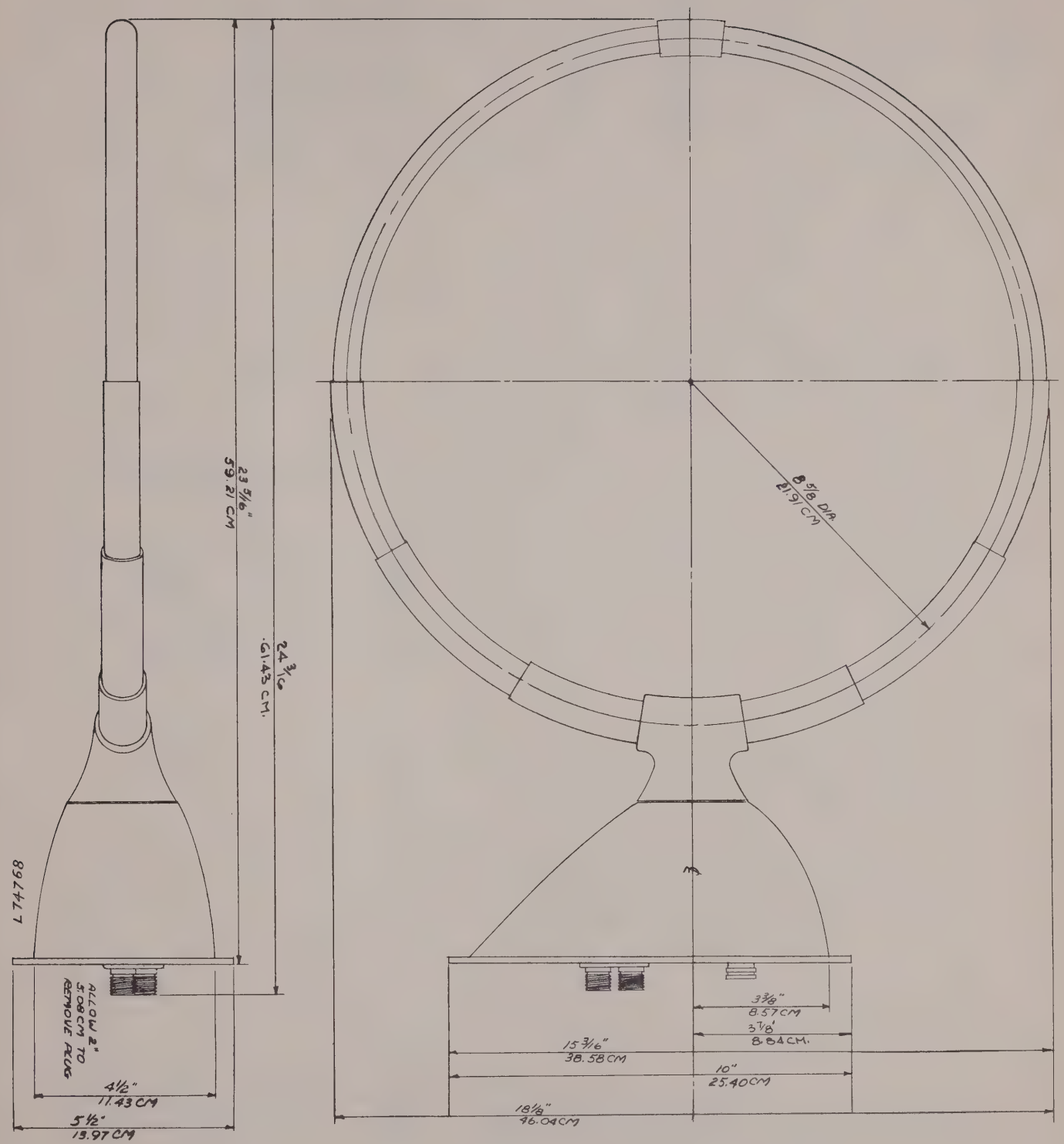


Fig. 11—Outline Dimensions, Type MN-24C Rotatable Loop

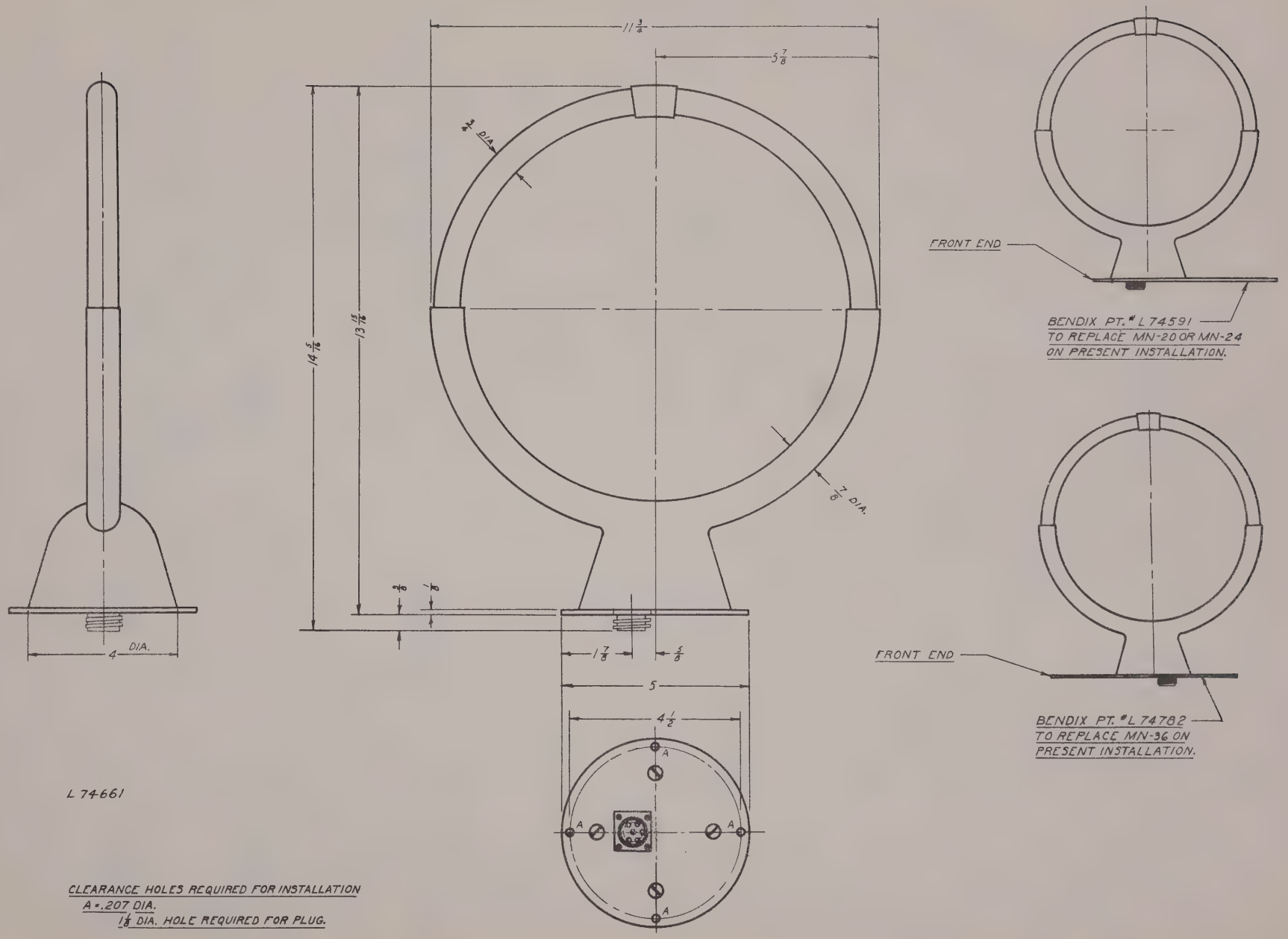


Fig. 12—Outline Dimensions, Type MN-46B Fixed Loop

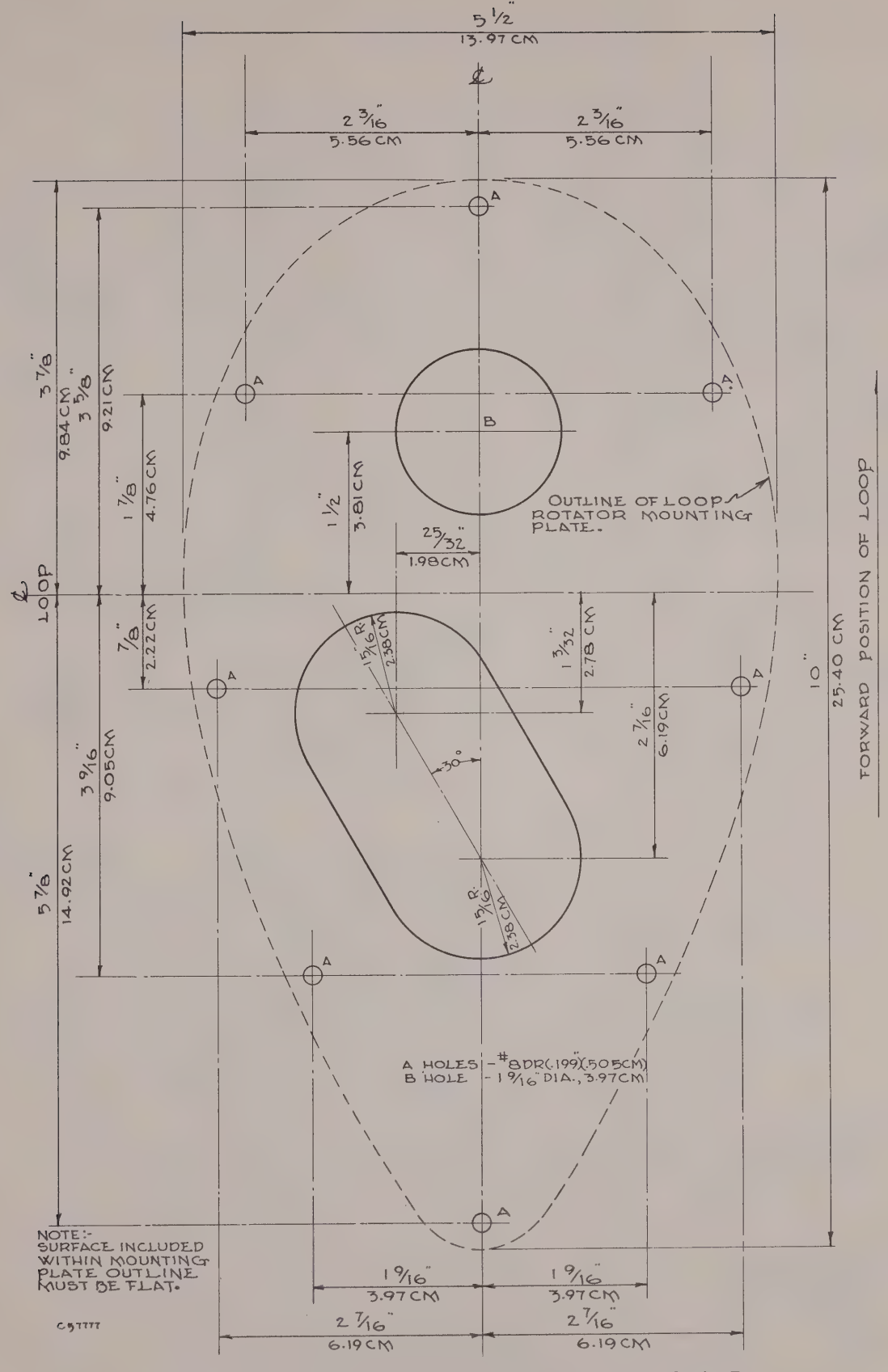


Fig. 13—Mounting Dimensions, Types MN-20E and MN-24C Loops

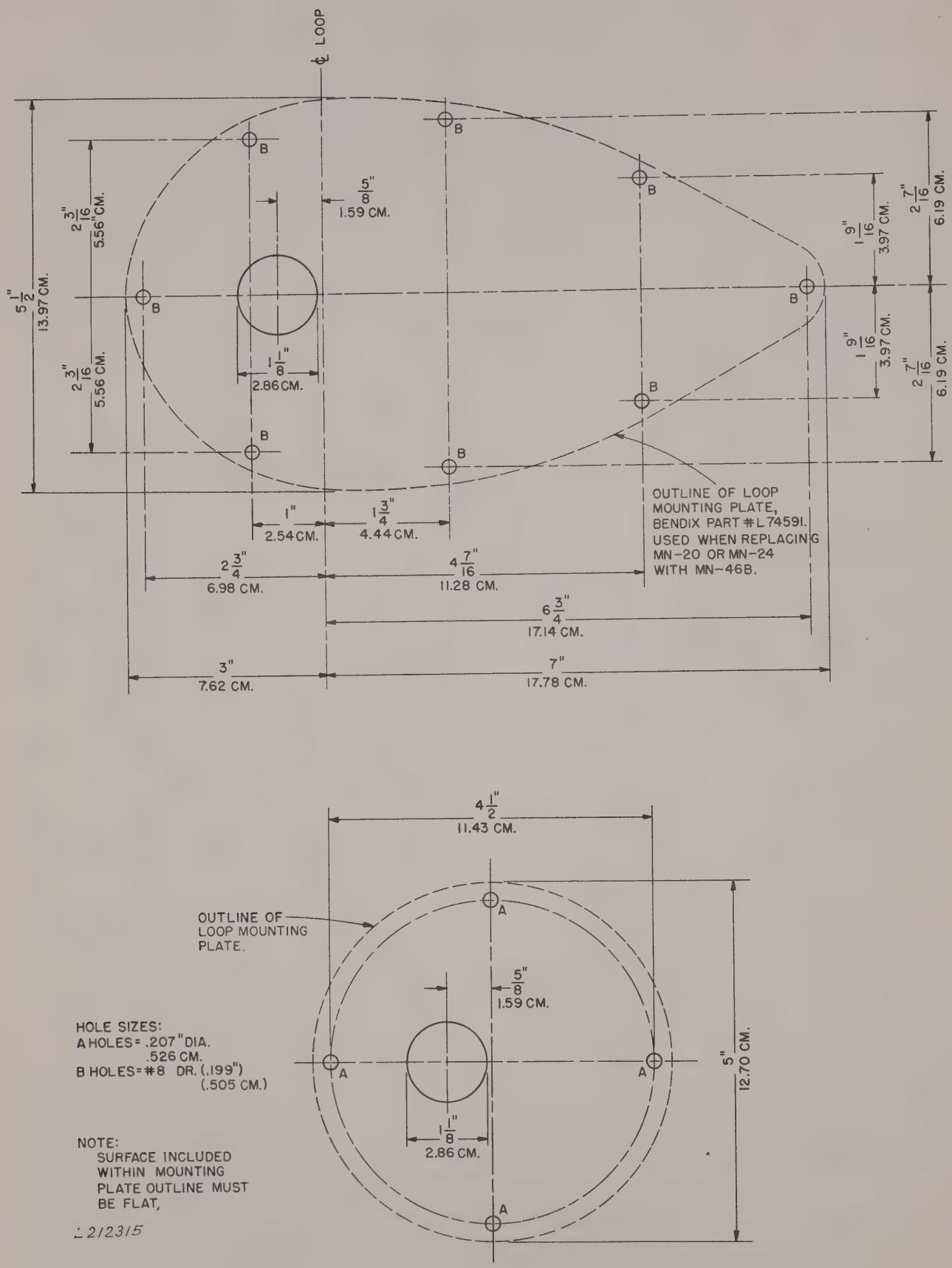
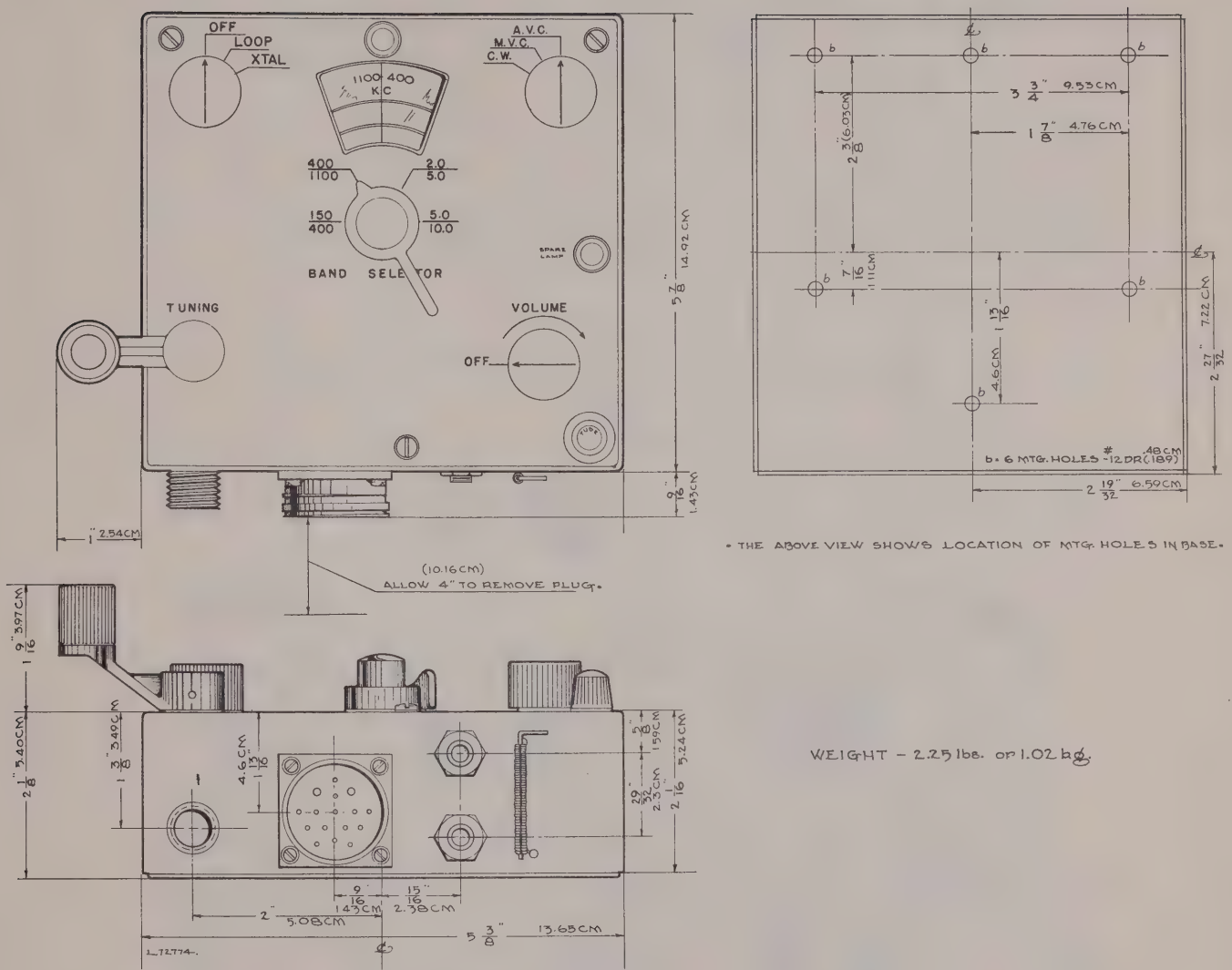


Fig. 14—Mounting Dimensions, Type MN-46B Loop



* THE ABOVE VIEW SHOWS LOCATION OF MTG. HOLES IN BASE.

WEIGHT - 2.25 lbs. or 1.02 kg.

Fig. 15—Outline and Mounting Dimensions, Types MR-9BB and MR-9CB Remote Control Units

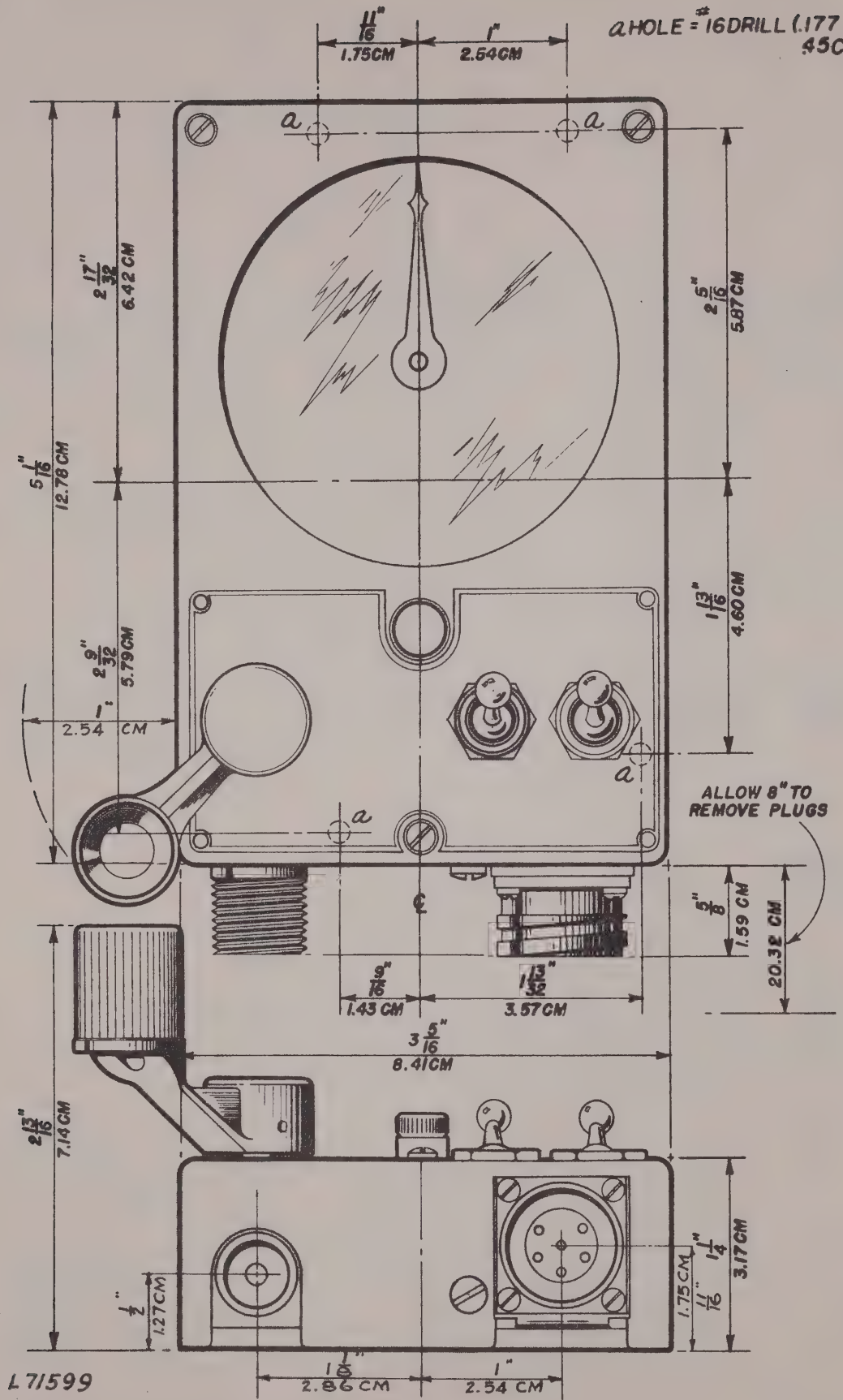


Fig. 16—Outline and Mounting Dimensions, Type MR-52JA Azimuth Control

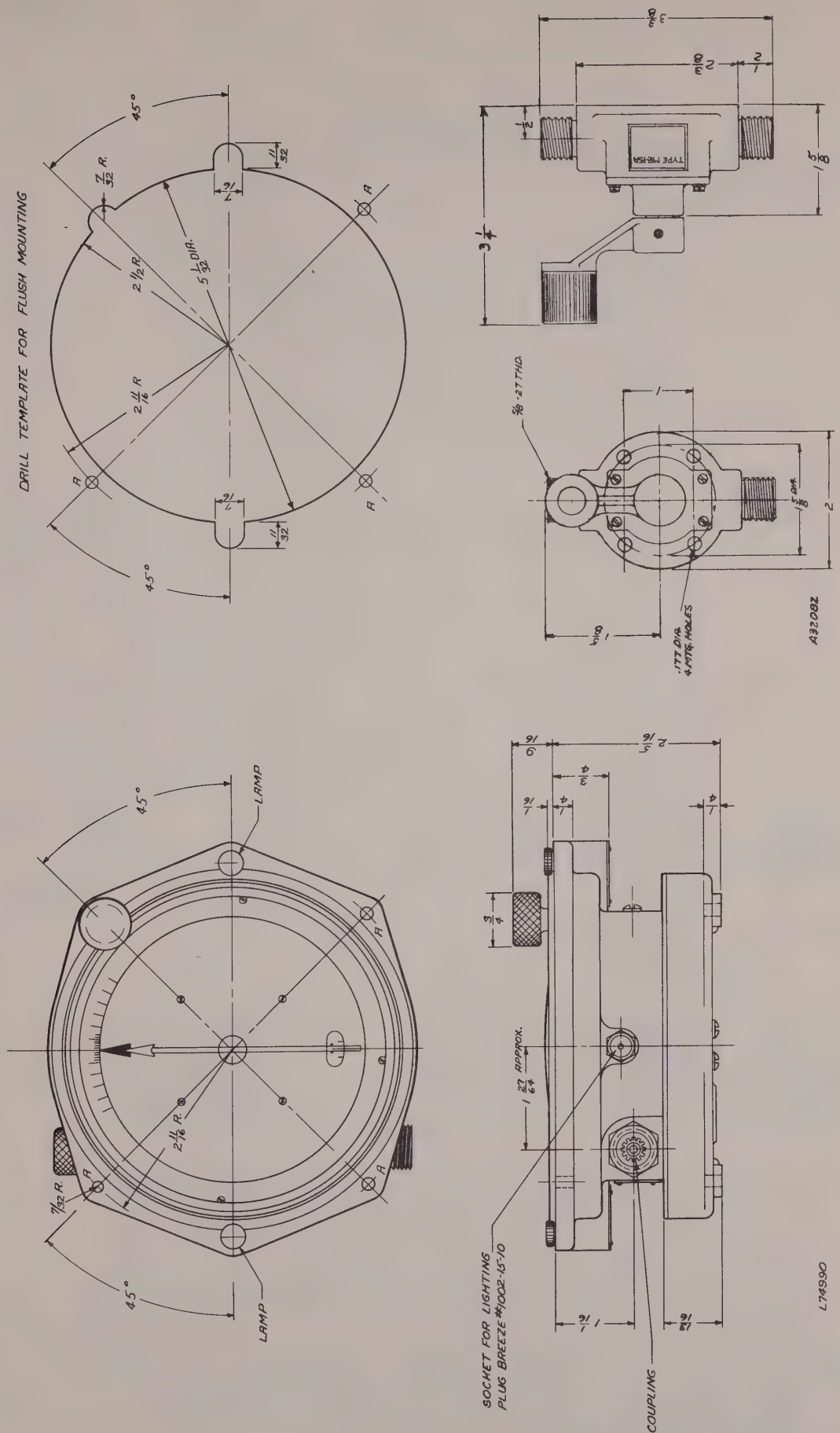


Fig. 17—Outline and Mounting Dimensions, Type MN-40D Azimuth Indicator and Type MR-15A Crank Drive

A113199

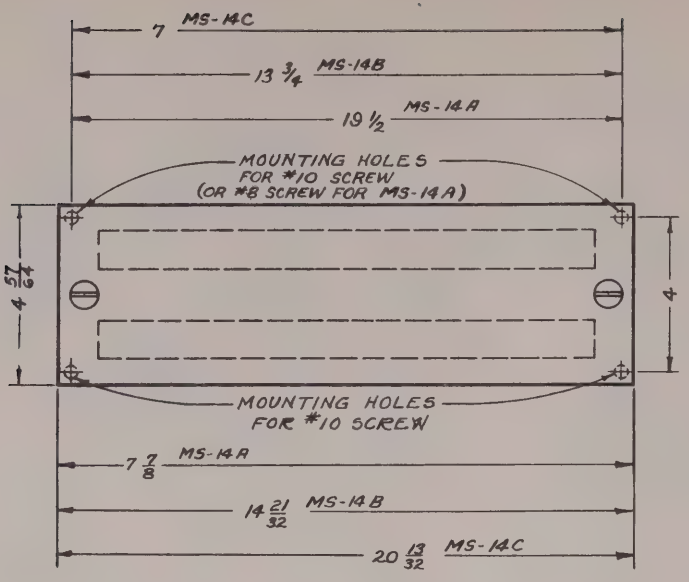
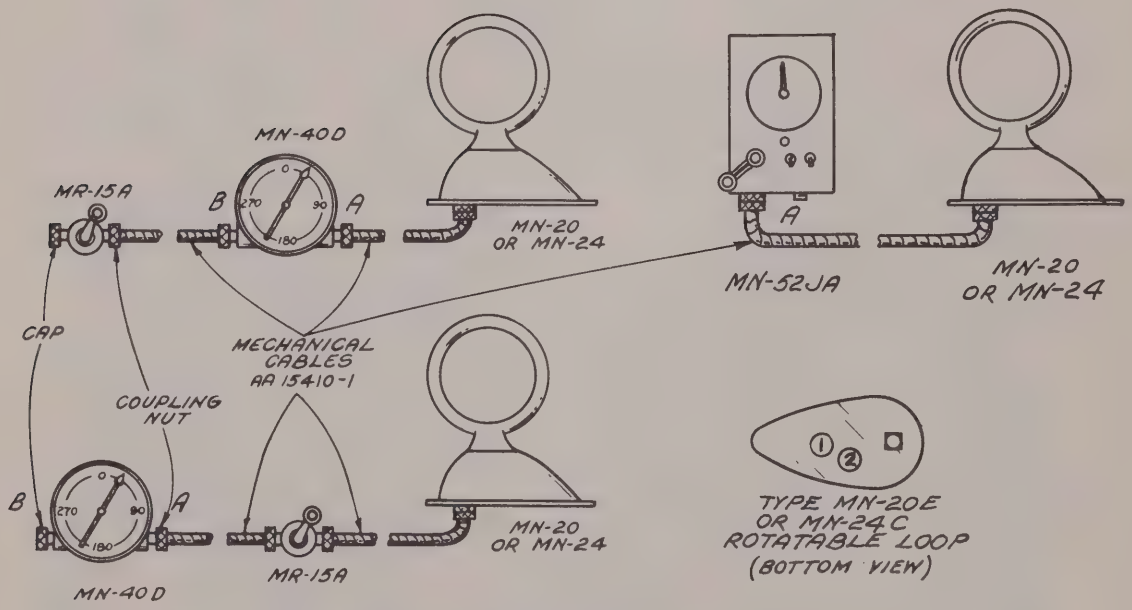


Fig. 18—Outline and Mounting Dimensions, Type MS-14 Junction Boxes



MOUNTING OF LOOP	LOOP CONTROL CABLE CONNECTION ON INDICATOR	LOOP CONTROL CABLE CONNECTION ON LOOP
TOP OF SHIP	A	1
TOP OF SHIP	B	2
BOTTOM OF SHIP	A	2
BOTTOM OF SHIP	B	1

NOTE: THIS CHART REFERS TO CABLE CONNECTION DRIVING THE LOOP. IN ANY CASE WHERE THE MN-40D IS USED, THE CRANK DRIVE MAY BE EITHER BETWEEN THE LOOP AND INDICATOR OR CONNECTED TO THE UNUSED INDICATOR CONTROL CABLE COUPLING.

C212316

Fig. 19—Tach Shaft Connections for Various Installations

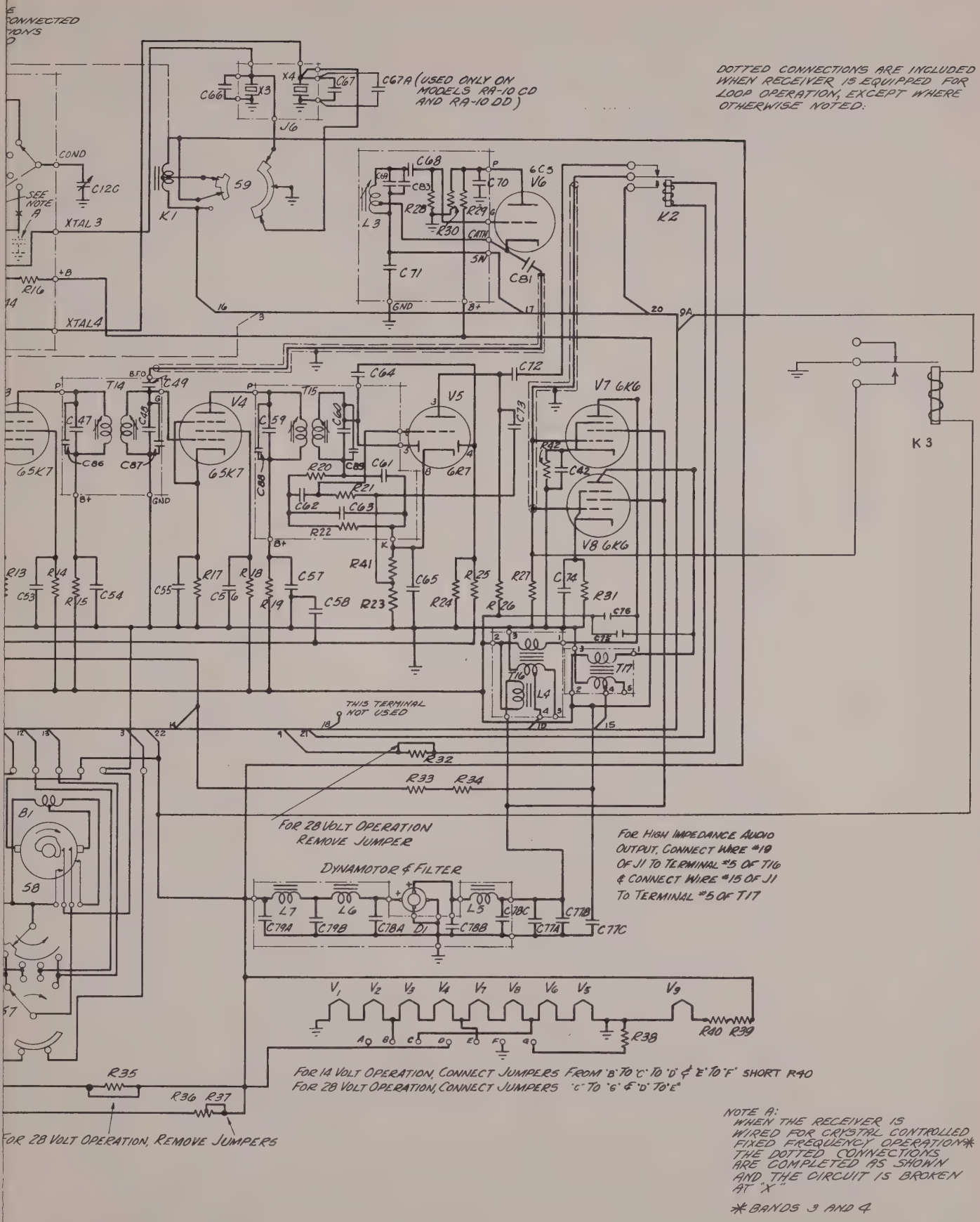

DOTTED CONNECTIONS ARE INCLUDED WHEN RECEIVER IS EQUIPPED FOR LOOP OPERATION, EXCEPT WHERE OTHERWISE NOTED:
C67A (USED ONLY ON MODELS RA-10 CD AND RA-10 DD)
SEE NOTE A
XTAL 3
XTAL 4
K1
K2
K3
V4 6SK7
V5 6R7
V6 6C5
V7 6K6
V8 6K6
THIS TERMINAL NOT USED
FOR 28 VOLT OPERATION REMOVE JUMPER
DYNAMOTOR & FILTER
FOR HIGH IMPEDANCE AUDIO OUTPUT, CONNECT WIRE #19 OF J1 TO TERMINAL #5 OF T16 & CONNECT WIRE #15 OF J1 TO TERMINAL #5 OF T17
FOR 14 VOLT OPERATION, CONNECT JUMPERS FROM 'B' TO 'C' TO 'D' & 'E' TO 'F' SHORT R40
FOR 28 VOLT OPERATION, CONNECT JUMPERS 'C' TO 'G' & 'D' TO 'E'
FOR 28 VOLT OPERATION, REMOVE JUMPERS
NOTE A:
WHEN THE RECEIVER IS WIRED FOR CRYSTAL CONTROLLED FIXED FREQUENCY OPERATION* THE DOTTED CONNECTIONS ARE COMPLETED AS SHOWN AND THE CIRCUIT IS BROKEN AT "X"
*BANDS 3 AND 4

Fig. 20—Schematic Diagram, Receiving and Direction Finding Components

A113199

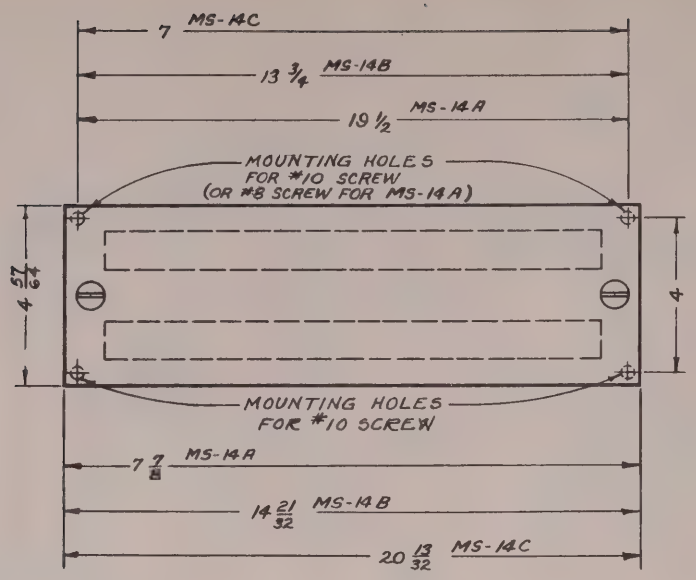
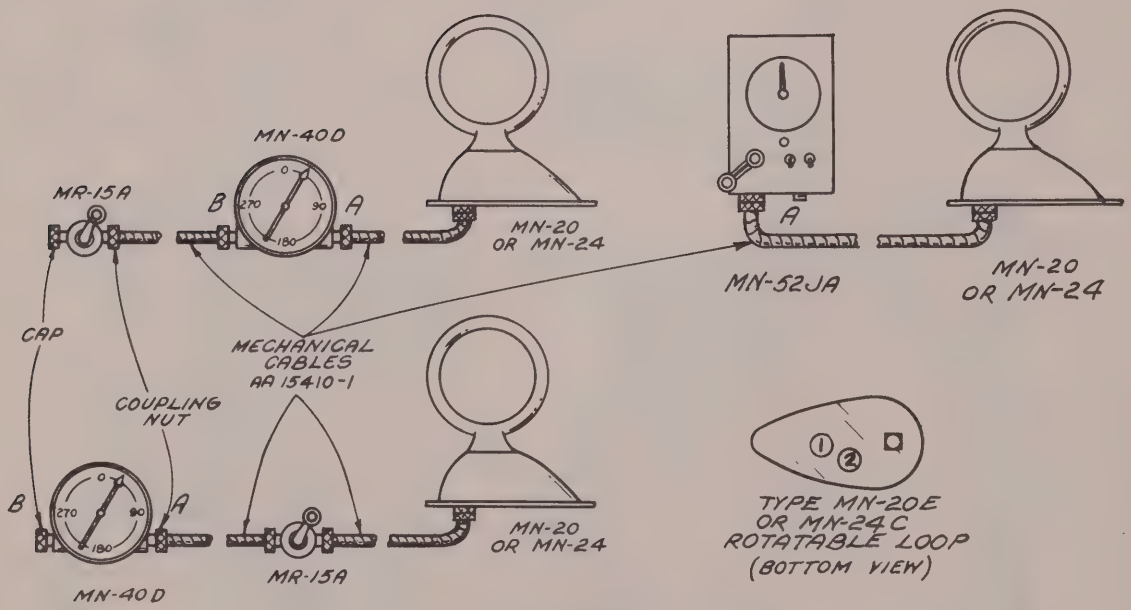


Fig. 18—Outline and Mounting Dimensions, Type MS-14 Junction Boxes



MOUNTING OF LOOP	LOOP CONTROL CABLE CONNECTION ON INDICATOR	LOOP CONTROL CABLE CONNECTION ON LOOP
TOP OF SHIP	A	1
TOP OF SHIP	B	2
BOTTOM OF SHIP	A	2
BOTTOM OF SHIP	B	1

NOTE: THIS CHART REFERS TO CABLE CONNECTION DRIVING THE LOOP. IN ANY CASE WHERE THE MN-40D IS USED, THE CRANK DRIVE MAY BE EITHER BETWEEN THE LOOP AND INDICATOR OR CONNECTED TO THE UNUSED INDICATOR CONTROL CABLE COUPLING.

C212316

Fig. 19—Tach Shaft Connections for Various Installations

THIS CONNECTION BROKEN WHEN RECEIVER IS EQUIPPED WITH MR-11C OR MR-11D LOOP RELAY UNIT

MR-11C OR MR-11D LOOP RELAY UNIT

MR-11C OR MR-11D LOOP RELAY UNIT AND MN-52JA AZIMUTH CONTROL FURNISHED ONLY WHEN RECEIVER IS EQUIPPED FOR LOOP OPERATION

IN MODLES RA-10CD AND RA-10DD THE OSCILLATOR CAN ASSY. BELOW IS CONNECTED AS SHOWN DOTTED. AND CONNECTIONS MARKED WITH AN X ARE OMITTED

DOTTED CONNECTIONS ARE INCLUDED WHEN RECEIVER IS EQUIPPED FOR LOOP OPERATION, EXCEPT WHERE OTHERWISE NOTED.

C67A (USED ONLY ON MODELS RA-10CD AND RA-10DD)

W-R-G

W-Y

W-BLUE

W-BLUE-BLK

BRN-YELLOW

W-BLUE

WHEN RECEIVER IS EQUIPPED WITH MR-11C OR MR-11D LOOP RELAY UNIT, ANTENNA CONNECTION IS MADE TO MR-11C OR MR-11D

FOR 28 VOLT OPERATION REMOVE JUMPER

THIS TERMINAL NOT USED

FOR 28 VOLT OPERATION REMOVE JUMPER

FOR HIGH IMPEDANCE AUDIO OUTPUT, CONNECT WIRE #19 OF J1 TO TERMINAL #5 OF T16 & CONNECT WIRE #15 OF J1 TO TERMINAL #5 OF T17

DYNAMOTOR & FILTER

FOR 14 VOLT OPERATION, CONNECT JUMPERS FROM 'B' TO 'C' TO 'D' & 'E' TO 'F' SHORT R40
FOR 28 VOLT OPERATION, CONNECT JUMPERS 'C' TO 'G' & 'D' TO 'E'

FOR 28 VOLT OPERATION, REMOVE JUMPERS

REMOTE PLUG P2

JUNCTION BOX MS-14B

RECEIVER PLUG P1 J1

2	9	WHITE-BLACK-GREEN	18
5	1	WHITE	10
6	2	GREEN-BLACK	11
7	3	ORANGE	12
8	5	BLACK-RED	14
9	7	BLACK-YELLOW	16
10	10	YELLOW	19
11	8	YELLOW-RED	17
12	4	GREEN-RED	13
13	6	BROWN-ORANGE	22
15	20	BROWN	9
1	19	BLACK	6
3	15	BROWN-YELLOW	4
4	17	BLUE-WHITE	7
	16	BLUE	8
	11	YELLOW-BLACK	15
	13	YELLOW-GREEN	20
	14	BROWN-RED	21
	18		1
			2
			23
			3
			5

JUNCTION BOX TERMINALS
19 GROUND
14 SIDETONE (RELAY)
13 SIDETONE (AUDIO)
11 AUDIO CHANNEL

CONNECT MN-40D DIAL LIGHT CABLE TO MS-14 JUNCTION BOX TERMINAL 6. GROUND SHIELD.

AZIMUTH INDICATOR

MR-9BB OR MR-9CB REMOTE CONTROL UNIT.-DOTTED CONNECTION BETWEEN S-101B AND S-102A IS USED WHEN EQUIPMENT IS ORDERED FOR CRYSTAL CONTROLLED FIXED FREQUENCIES ONLY ON BANDS 3 AND 4.

R212313

NOTE A:
WHEN THE RECEIVER IS WIRED FOR CRYSTAL CONTROLLED FIXED FREQUENCY OPERATION* THE DOTTED CONNECTIONS ARE COMPLETED AS SHOWN AND THE CIRCUIT IS BROKEN AT 'X'

* BANDS 3 AND 4

Fig. 20—Schematic Diagram, Receiving and Direction Finding Components

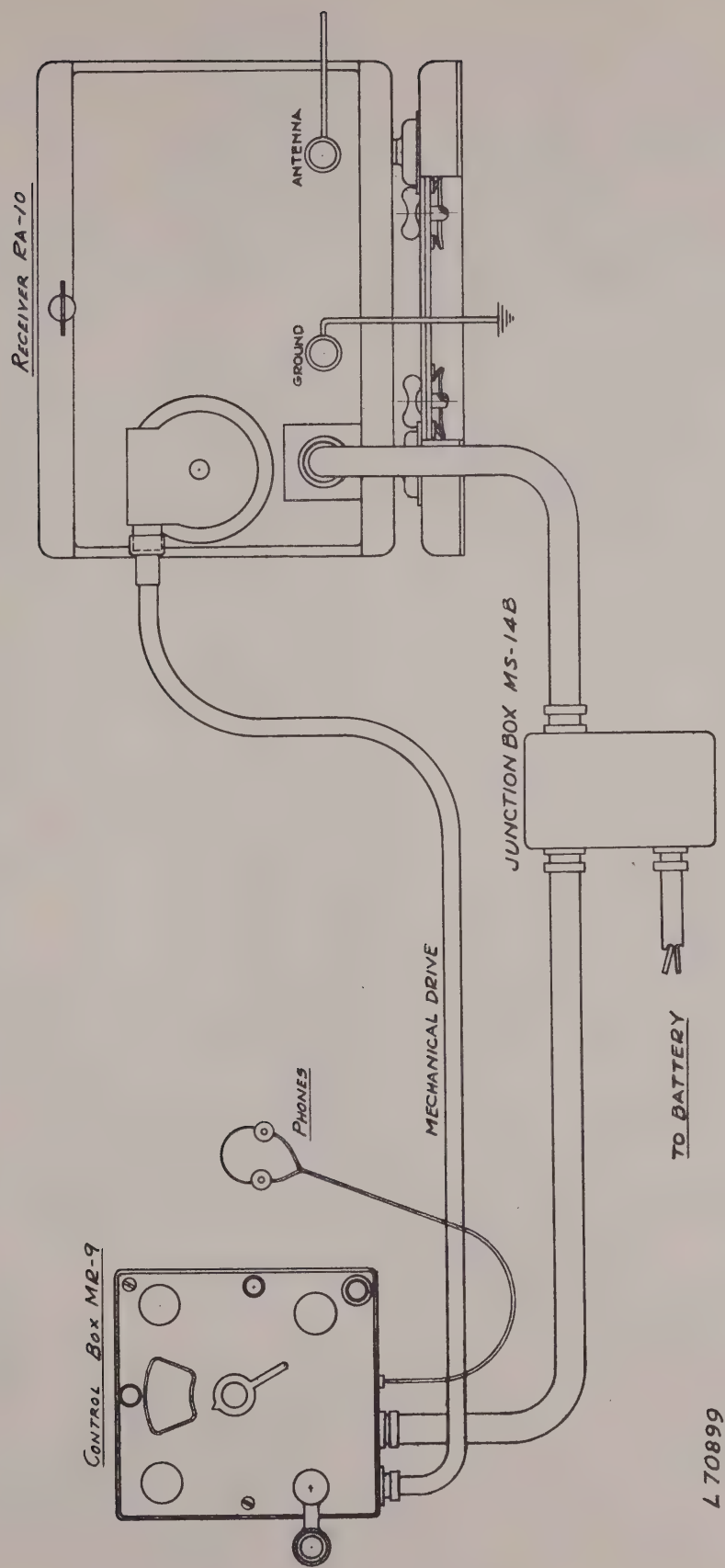


Fig. 21—Cordage Diagram, Receiving Components

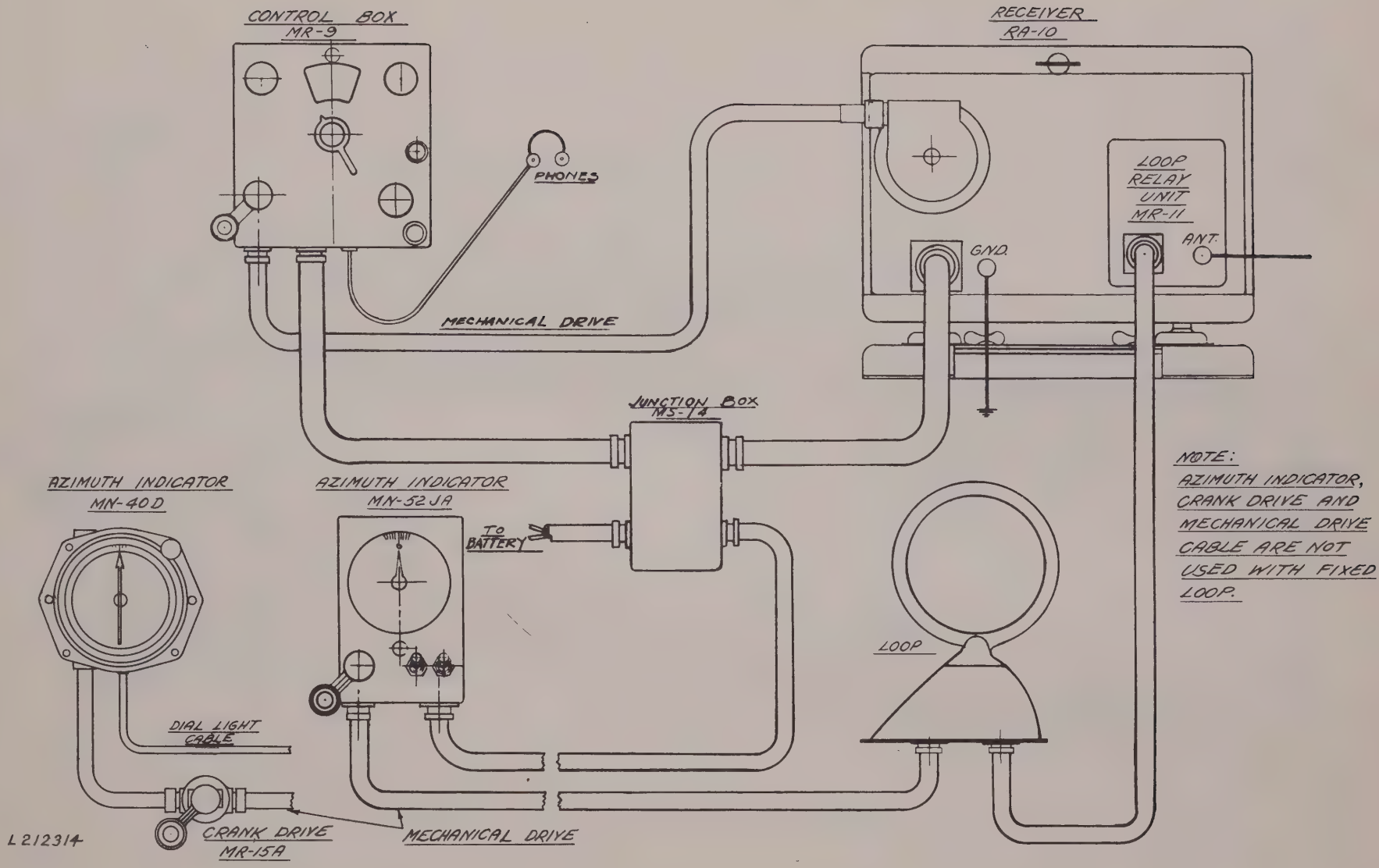


Fig. 22—Cordage Diagram, Direction Finding Components

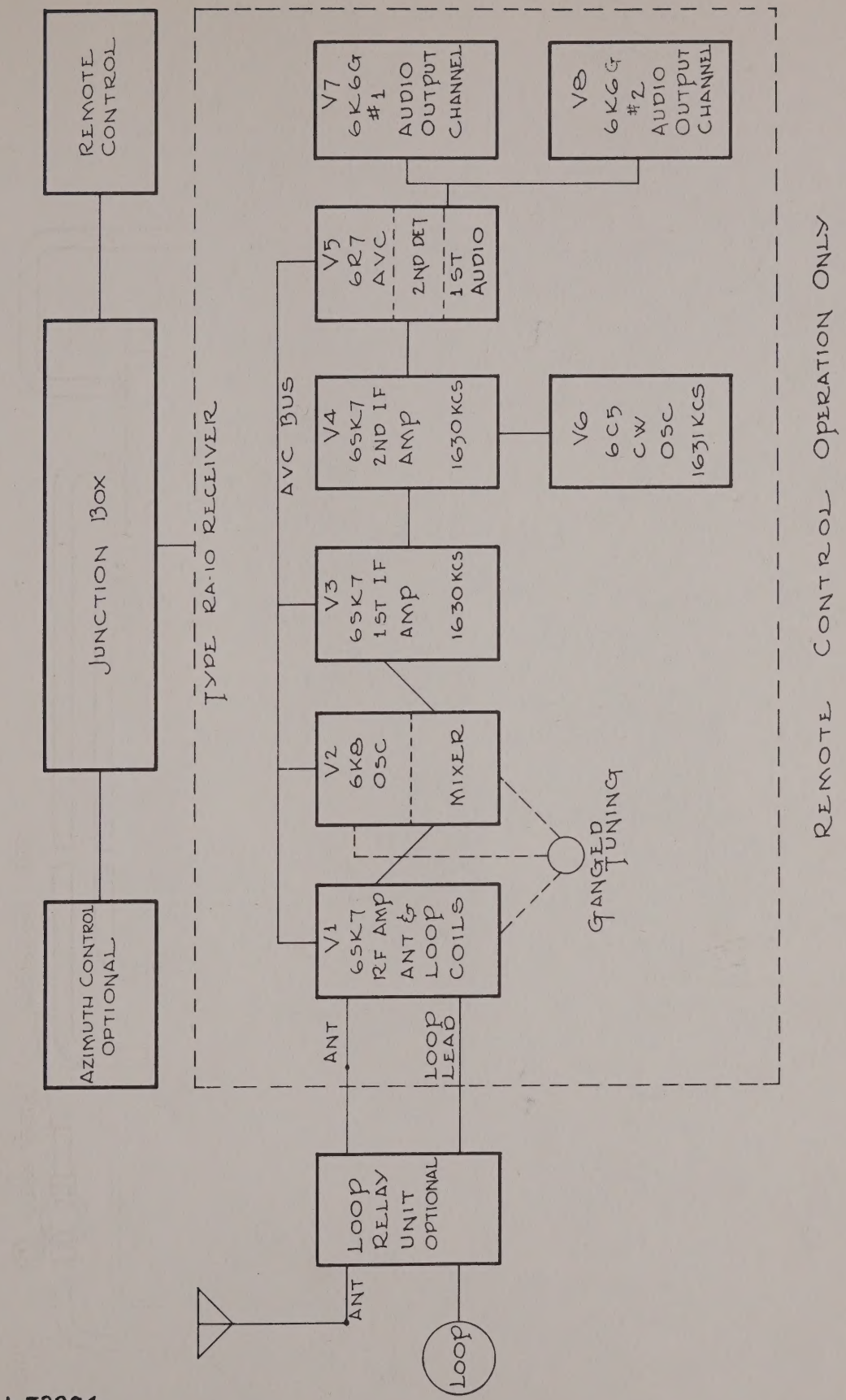


Fig. 23—Block Diagram, Types RA-10C, RA-10D, RA-10CD and RA-10DD Receivers